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THESIS

BUSINESS WARGAMING:
APPLICATIONS FOR
MARINE CORPS MANPOWER POLICY DECISIONS

By

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March 2000

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Complexity is abundant in nature, in society, and in the workplace. The business sector has recently experimented with business wargaming, which is based upon complex adaptive systems theory, as a tool for policy analysis and management training. Business wargames, based upon agent-based simulation technology, provide a flexible platform using software agents that are programmed with simple rules, interact with each other and their environment. This interaction leads to emergent behavior, which evolves from the collective interaction and adaptation of these agents. This thesis discusses the experiences and lessons learned from the U.S. Army's Firm Handshake Proof of Principle business wargame, and applies them to a Marine Corps' counterpart game called SimMarineCorps. SimMarineCorps will model the Marine Corps' Human Resource Development Process (HRDP). This architecture consists of players, screens, agents, rules of engagement, and relationships among and between the players and agents. Critical success factors for SimMarineCorps is General Officer support to ensure that the necessary data/metrics are collected and validated.

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BUSINESS WARGAMING: APPLICATIONS FOR MARINE CORPS MANPOWER POLICY DECISIONS

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Major, United States Marine Corps
B.A., Illinois Institute of Technology, 1987

Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Complexity is abundant in nature, in society, and in the workplace. The business sector has recently experimented with business wargaming, which is based upon complex adaptive systems theory, as a tool for policy analysis and management training. Business wargames, based upon agent-based simulation technology, provide a flexible platform using software agents that are programmed with simple rules, interact with each other and their environment. This interaction leads to emergent behavior, which evolves from the collective interaction and adaptation of these agents. This thesis discusses the experiences and lessons learned from the U.S. Army's Firm Handshake Proof of Principle business wargame, and applies them to a Marine Corps' counterpart game called SimMarineCorps. SimMarineCorps will model the Marine Corps' Human Resource Development Process (HRDP). This architecture consists of players, screens, agents, rules of engagement, and relationships among and between the players and agents. Critical success factors for SimMarineCorps is General Officer support to ensure that the necessary data/metrics are collected and validated.

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I. INTRODUCTION/BACKGROUND

A. AREA OF RESEARCH

In an era of shrinking budgets the Department of Defense (DoD) has turned to simulation to enhance and, in some instances, to replace costly and time-consuming training. These simulations take full advantage of today's technology to attain high benefit for relatively low cost. One method of designing simulations to save money and time, and to incur less risk is through the use of "agent-based simulation" (ABS). Agent-based simulation differs from traditional simulation methods in that individuals are modeled as software agents in an attempt to explicitly simulate the overall market behavior of these individuals' nonlinear interactions with each other and with the environment. This property of ABS is referred to as "emergent behavior" and its basis lies in the algorithms that can be found in our own genetic make-up.

ABS is finding fertile application in the area of business wargaming. Many companies are using this technology to test business decisions prior to their implementation. The U.S. Army is developing an ABS called SimArmy/Firm Handshake to simulate manpower policy decisions and the effects they may have within the Army manpower

community. This thesis uses the SimArmy/Firm Handshake business wargame as a springboard to design a Marine Corps counterpart for Marine Corps manpower decisions. The focus will be to define requirements in the form of key players, agents, attributes, and rules of engagement for a Marine Corps version of SimArmy/Firm Handshake called SimMarineCorps.

B. OBJECTIVE

The objective of this thesis is to examine the phenomenon of complex adaptive systems and how it might be applied to Department of Defense (DoD) policy and decision-making. This will be done in support of the Marine Corps' efforts to develop an agent-based simulation. This model will simulate some of the business processes within the Marine Corps Human Resource Development Process (HRDP) in order to evaluate various manpower policy decision tradeoffs.

C. RESEARCH QUESTIONS

This thesis will answer the following research questions:

1. How can the theory of complex adaptive systems be applied to military manpower analysis?

2. What are the lessons learned from applying ABS to the Army manpower community as experienced in the SimArmy/Firm Handshake business wargame?
3. How can an ABS be constructed to capture meaningful elements of Marine Corps manpower decision-making? Specifically:
    - Who are the Key players in Marine Corps manpower decisions?
    - What are the necessary agents and attributes for programming and conducting SimMarineCorps?
    - What are the rules of engagement for programming and conducting SimMarineCorps?
    - What readiness metrics should be used in conjunction with the SimMarineCorps game?

D. DISCUSSION

Simulation has taken on an ever-increasing role in all aspects of military affairs, from improving training to simulating combat to testing policy decisions. The advantages of simulation include a better understanding of the real system without the commitment of costly resources such as lives, equipment and capital. This understanding is possible in part because years of experience in a real system can be compressed into hours, minutes, and even seconds. Further, the ability to vary parameters and

conduct "what if" analyses facilitates the analysis of different scenarios at a relatively low cost. Traditional simulations have limitations because they are based on discrete event, continuous, and Monte Carlo simulations, which are mathematical models that represent the physical objects. These traditional simulations are based on exact, deterministic equations and are often inadequate to cope with the complex, nonlinear systems that exist in the commercial and defense sectors.

To simulate these complex systems the commercial sector has turned to a form of simulation called "agent-based simulation" (ABS). ABS differs from traditional simulation methods in that the simulated entities are modeled as individual objects or agents in an attempt to simulate the specific behaviors of these individual entities. In ABS, the agent is defined in terms of its behavior (procedural rules) and characteristics (parameters) and represents a component part of a natural system or environment. These software agents are used to model individuals' behaviors whereas the behaviors of firms or organizations are captured by human players within the simulation. DoD has just begun to scratch the surface with respect to recognizing the potential benefits that ABS can afford. One area that DoD is investigating the use of ABS is in simulating manpower

policy decisions. A team comprised of the Naval Postgraduate School, Purdue University, and the Army Center for Land Warfare have developed an agent-based simulation for examining Army manpower policy decisions called Firm Handshake.

This thesis will apply the lessons learned from the Firm Handshake simulation in combination with research and interviews with key manpower decision makers from the U.S. Marine Corps to identify specific requirements of key players, agent attributes, and rules of engagement for a Marine Corps version of Firm Handshake.

E. SCOPE OF THESIS

The scope of this thesis will include: (1) a review of Complexity Adaptive Systems Theory, (2) a review of Agent Based Simulation, (3) an analysis of applications of Agent Based Simulation in DoD, and (4) a review of lessons learned from the U.S. Army's Firm Handshake simulation. The thesis will conclude by identifying the objectives and requirements for SimMarineCorps agents, including the key manpower players/teams, the structure of SimMarineCorps, the recommended player controls/screens, the relationships between each screen/team, the agent relationships/metrics,

the scenarios for a Proof of Principle exercise, and identification of any data/metric shortfalls.

This thesis will not in any way build, calibrate, or test the actual SimMarineCorps simulation itself; this will be done by Purdue University.

F. METHODOLOGY

The methodology used in this thesis research will consist of the following steps.

1. Conduct a literature search of simulation in DoD, business wargaming, complex adaptive systems theory, and agent-based simulation.
2. Compile lessons learned from the Firm Handshake business wargame.
3. Develop a methodology for gathering ABS requirements.
4. Apply ABS requirements methodology to SimMarineCorps.
5. Provide recommendations based upon the study.

G. BENEFITS OF THE STUDY

This study will provide the necessary information required to implement a Marine Corps-centered agent-based simulation for Manpower Policy Decisions. The benefits of this form of simulation are to provide insight, experiential

learning, team building, leadership development, and risk-free strategy testing for manpower decisions.

H. OVERVIEW OF CHAPTERS

The remainder of the thesis is structured as follows:

- ***Literature Review:*** This chapter will examine and present the literature concerning simulation modeling in DoD, Complex Adaptive Systems, Agent-based simulation, and the Synthetic Environment for Analysis and Simulation (SEAS).
- ***Overview of U.S. Marine Corps' Human Resource Development Process:*** *This* chapter will provide an overview of the HRDP, focusing on Manning, Recruiting, and Training.
- ***U.S. Army's Firm Handshake Proof of Principle Exercise:*** This chapter will provide an extensive overview of the U.S. Army's Firm Handshake business wargame and present the results and lessons learned of the Proof of Principle exercise.
- ***SimMarineCorps:*** This chapter will define SimMarineCorps in terms of objectives, structure, screens, screen relationships, agent relationships/metrics, data requirements and data shortfalls.

- ***Summary/Conclusions:*** This chapter will summarize the conclusions from the thesis and recommend areas of future study.

II. LITERATURE REVIEW

This chapter will provide an overview of simulation and modeling in the Department of Defense (DoD) as a backdrop against which to consider the technology of agent-based simulation. We will then define and give examples of complex adaptive systems, and explain how DoD and the Marine Corps can be considered as complex adaptive systems. We will then show how complex adaptive systems can be modeled using agent-based simulation and explain the key components of agent-based simulation (agents, rules, environment, and emergent behavior). This chapter will conclude with a review of the programming environment used in SimArmy/Firm Handshake, the Synthetic Environment for Analysis and Simulation (SEAS), and how it supports agent-based simulation.

A. SIMULATION AND MODELING IN DOD

Computers are changing the face of everything in the contemporary world from the way we conduct business, to the way we educate, to the way we look at reality. Computers have also allowed us to make great strides is in generating models that simulate various processes that we encounter in our everyday lives and business. The computer's capabilities for rapidly performing many more arithmetic or

logical operations than the human mind gives it a prominent role in addressing problems of great complexity.[1] This ability of the computer has led to its widespread use in simulation. Simulation can lead to a better understanding of a "real world" system by compressing "real" years into "computer" hours, minutes, or even seconds. Today's simulations also allow decision-makers to vary parameters of a simulation to answer "what if" questions. Ultimately, through the proper use of simulation, the decision-maker can save money and time, and incur less risk.[2]

Prior to 1990, the field of Modeling & Simulation (M&S) was marked by fragmentation and limited coordination of activities across key communities (e.g., across Service lines and across functional communities).[3] This lack of coordination led the Deputy Secretary of Defense to assign overall management responsibility of all DoD M&S to the Defense Modeling & Simulation Office (DMSO) in 1991.[4] The creation of DMSO was intended to maximize the effectiveness

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[1] RAND Note, *Exploratory Modeling and the Use of Simulation for Policy Analysis,* by S.C. Bankes, p. 26, 1992

[2] Turban, E., *Decision Support Systems and Intelligent Systems,* Fifth Edition, Prentice Hall, pp. 164, 1995

[3] Department of Defense Regulation 5000.59-P, *DoD Modeling and Simulation (M&S) Master Plan,* October 1995, Chapter 3, Available online at: http://www.dmso.mil/documents/policy/msmp/chapter_3.html

[4] Ibid. Chapter II

and efficiency of M&S efforts across DoD, as well as foster interoperability and reuse throughout functional areas. To accomplish this mission DMSO created a unifying vision, the main thrusts of which are:

- To provide readily available, operationally valid environments for use by DoD Components.
- To train jointly, develop doctrine and tactics, formulate operational plans, and assess warfighting situations.
- To support technology assessment, system upgrade, prototype and full-scale development, and force structuring.
- To promote common use and a closer interaction between the operation and acquisition communities in carrying out their respective responsibilities.
- To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.[5]

This vision also entails providing substantially improved capabilities and decision-making in each of the four pillars of military capability: readiness, modernization, force structure, and sustainability. Figure 2.1 shows the range of M&S embraced by the DoD M&S vision.

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[5] Ibid.

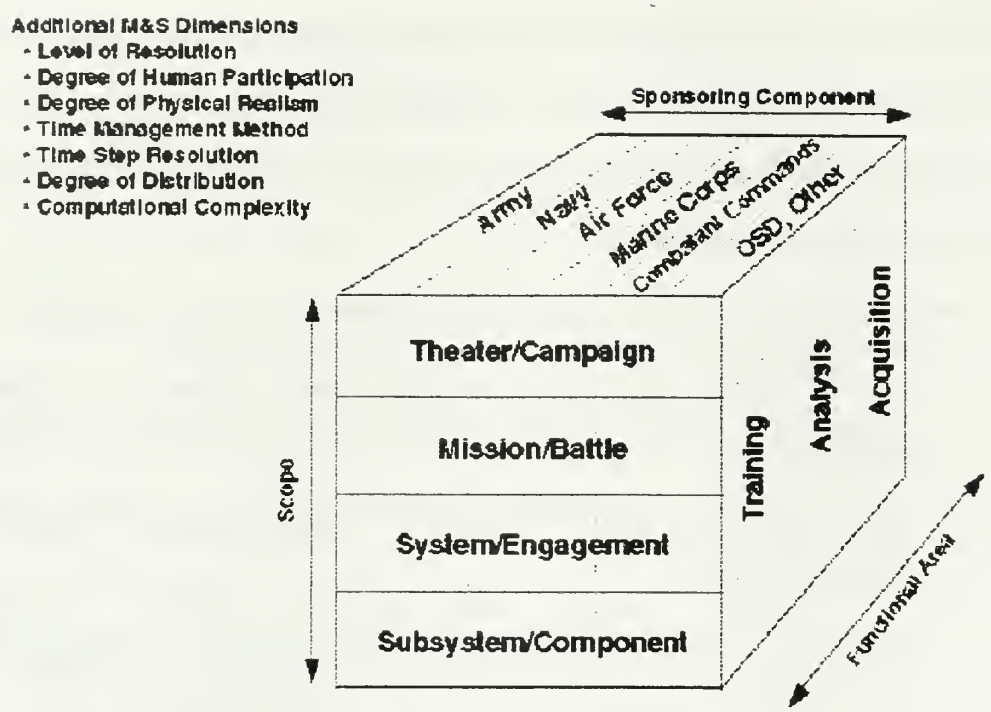

Figure 2.1 -- Range of M&S Embraced by the DoD M&S Vision[6]

It is easy to see that the vision fully encompasses the business processes of all services across all functional areas. To transform the M&S vision into reality, DMSO has identified six necessary activities: Provide Management, Policy & Guidance, Assess M&S Requirements, Develop Technology, Build M&S Capability, Field the Capability, and Share the Benefits of M&S (Figure 2.2).

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[6] Ibid.

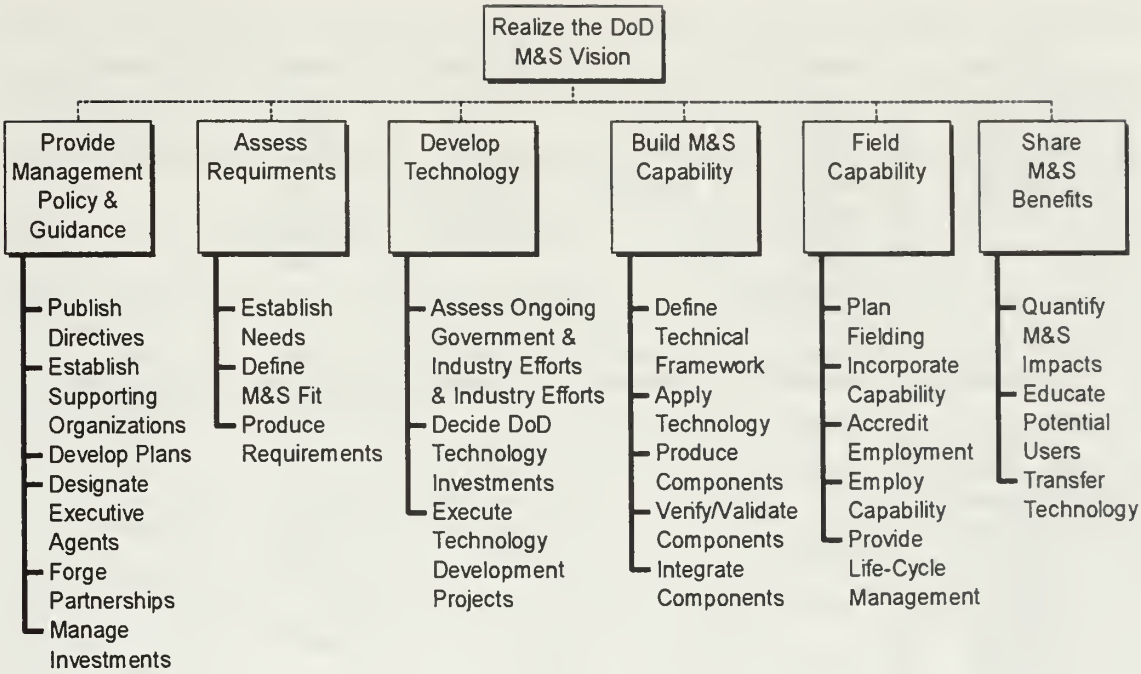

Figure 2.2 -- DoD M&S Activity Model

DMSO conducted an assessment of the then current M&S in DoD to identify shortfalls that would need to be overcome in order to realize their overall vision. DMSO identified six objectives that needed to be met (Figure 2.3) as well as the logic for deriving these objectives (Figure 2.4).

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6
Develop a Common Technical Framework for M&S	Provide Timely and Authoritative Representations of the Natural Environment	Provide Authoritative Representations of Systems	Provide Authoritative Representations of Human Behavior	Provide a M&S Infrastructure to Meet Developer and End-User Needs	Share the Benefits of M&S
Sub-Objectives	**Sub-Objectives**	**Sub-Objectives**	**Sub-Objectives**	**Sub-Objectives**	**Sub-Objectives**
1-1: High Level Simulation Architecture 1-2: Conceptual Models of the Mission Space 1-3: Data Standardization	2-1: Terrain 2-2: Oceans 2-3: Atmosphere 2-4: Space	None	4-1: Individuals 4-2: Groups and Organizations	5-1: Field Systems 5-2: VV&A 5-3: Repositories 5-4: Communications 5-5: Coordination Center	6-1: Quantify Impacts 6-2: Education 6-3: Dual-use

Figure 2.3 -- DoD M&S Objectives and Sub-Objectives[7]

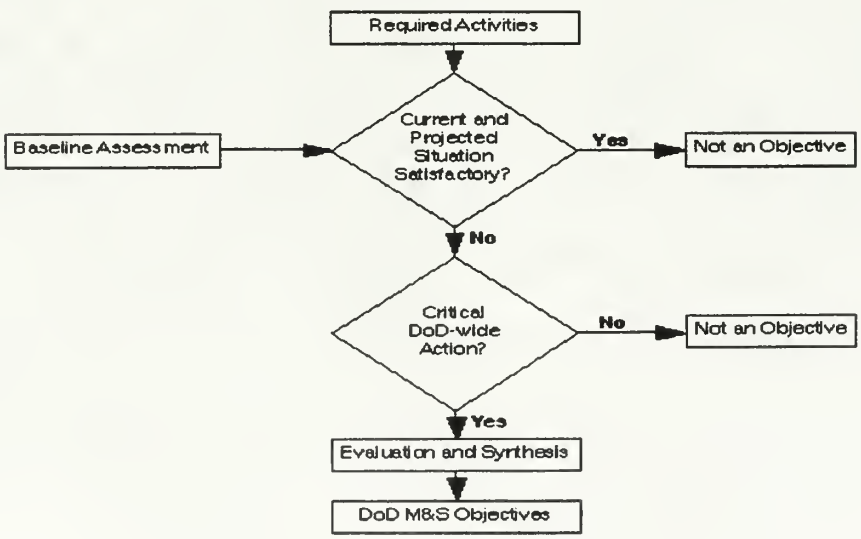

Figure 2.4 -- Logic for Deriving M&S Objectives[8]

[7] Ibid.

[8] Ibid.

Over the past decade, DoD has taken significant steps to improve its way of developing, integrating, and fielding models and simulation. DoD's overview of simulation can be summarized as; "All aspects of preparing for war can be improved through the use of computer simulation."[9]

B. BUSINESS WARGAMING

One of DoD's principal interests in simulation is to conduct various kinds of wargaming. Military gaming serves three purposes: training military personnel, testing plans, and research, e.g., to explore new concepts.[10] Gaming is used not only in DoD, but by the business sector as well. Business wargaming can be considered the management counterpart of combat simulations. Gaming in the business sector was adapted from wargaming in 1956 by the American Management Association (AMA).[11] The AMA went to the Naval War College and enlisted the cooperation of International Business Machines (IBM) Corporation. The goal was to build a mathematical model of business consisting of cause-and-effect formulas, which could be used to determine the

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[9] Joint Simulation System (JSIM), Mission Needs Statement, available online at: [http://www.jwfc.js.mil/PAGES/jsims/descrp.html],1998

[10] Hausrath, Alfred, H., *Venture Simulation in War, Business, and Politics,* p.18, McGraw-Hill Book Company, 1971

[11] Ibid. p. 194

results of each set of decisions made in the game.[12] Since 1956 the area of business wargames has grown rapidly. Many business programs at universities use some form of gaming in their curriculum. Also, many management-training programs use gaming as a means to train managers and decision-makers. Gaming is also finding its way directly into the boardroom, assisting managers with making everyday decisions. First, we will look at the similarities and differences between military wargaming and business wargaming.

The similarities between wargaming and business wargaming include features pertaining to the actual game and simulation models, the facilities and equipment, and the administrative details. The models used by both kinds of games are interactive, and provide feedback to the user. The data used can be individual or aggregate and can be deterministic or probabilistic. In terms of the facilities each game requires enough space for individuals and teams to workk a place to conduct briefings, and enough room to allow for the separation of the controller and various teams. Equipment can range from paper and pencil to complex computer installations. On the administrative side it is critical for both to include some form of controller or game

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[12] Ricciardi, Franc, M. et al., in Elizabeth Marting (ed.), *Top Management Decision Simulation,* pp. 6, 59, New York, American Management Association, 1957, as quoted by Hausrath, p. 194

master to keep the simulation on course. Also the game needs to be divided into logical cycles or periods. Lastly, both types of wargaming (military and business) require expert leadership thoroughly familiar with the game to allow for a smooth gaming process.[13]

A major difference between business and military wargaming is that in military wargaming we are simulating a battlefield whereas in business wargaming, battles are fought in marketplaces. Business wargaming allows us to experiment with alternative management (vice battlefield) decision making-policies. However, the major difference between business wargaming and combat simulation is the technology that is currently used to model each. Combat simulations tend to favor a top down, discrete event approach, wherein business wargaming relies upon bottom up, agent-based simulation. The use of software agents to model complex adaptive systems involving market-driven behavior is the distinguishing feature of agent-based simulations.

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[13] Hausrath, Alfred, H., *Venture Simulation in War, Business, and Politics,* pp.202-203, McGraw-Hill Book Company, 1971

C. AGENT-BASED SIMULATION

1. Complex Adaptive Systems (CAS)

Thus far we have discussed models and simulation in DoD, and the similarities and differences between military and business wargaming. "For the last quarter-century, scientists and theoreticians have increasingly focused attention on problems relating to chaos, complexity, randomness, nonlinearity, uncertainty, and turbulence."[14] What has resulted from this increased interest in complexity is the realization that quite intricate, or complex, behavior can emerge from the interaction of individual components programmed with a relatively simple set of rules that guide behavior.

Before complexity theory was applied to the business world it had already been developed extensively from studying complex systems in nature, e.g., the evolution of species, or the algorithms that govern our own genetic make-up. One of the better known models used to understand complexity was developed at the Santa Fe Institute by Stuart Kaufman. Kaufman's "NK model" was used to measure the ability of genes to affect the fitness of genes on other

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[14] Beaumont, Roger, *War, Chaos, and History*, p. 1, Praeger Publishers, 1994

parts of chromosomes.[15] The "NK" refers to the fact that a species has N genes and each of those genes depends on the interaction with K other genes for its fitness. The NK model can also be used to understand a marketplace, i.e., one can consider N to represent firms in a particular market, and K to represent the number of conflicting constraints or tradeoffs between and among firms and the other external markets (e.g., limited resources, patented technology, regulations, etc.). Thus, like systems in nature, market-driven systems within the business sector or the DoD can be considered complex systems and both can be considered as, and modeled as, Complex Adaptive Systems (CAS).

CAS can be described as systems having elements or entities (e.g., customers, competitors, and workers) that adapt their behavior to each other and their environment.[16] We have described some examples of CAS above which include markets, ecosystems, and social systems. Each system has individuals that interact according to a certain set of rules; these govern agent-agent, agent-environment, and environment-environment interactions. Behavior emerges from

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15 Kauffman, S. *At Home in the Universe,* pp.169-189, Oxford University Press, 1995

16 Thinkingtools, *Agent Based Adaptive Simulation,* [http://www.thinkingtools.com/html/technology.html], 1999

the multiple interactions amongst these relationships. Another example of a scenario that meets the description of a CAS is a typical combat zone. "Individual servicemen and weapons systems can be modeled as agents, interacting and adapting based on the behavior of each other and the environment."[17] It is logical to conclude then, that if we can apply CAS to combat we may also extend it to other functional areas in DoD such as manpower or acquisition. The next sections discuss concepts and terminology related to CAS and agent-based simulation, and suggest how agent-based simulation can be used to model complex adaptive systems such as the Marine Corps.

2. Introduction to Agent-based Simulation

The complex environments or CAS described above present researchers and managers with many difficult modeling issues. One way to study CAS is through the use of computer simulations - called adaptive, agent-based simulation (ABS). ABS uses individual software agents that represent individuals or organizations. These agents are coded with rules of behavior, which describe how the agent should interact with its environment. What makes an agent adaptive is that it can revise its rules of behavior based on what it

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[17] Pollack, John, F., *Agent Based Simulation and Its Applicability to the DoD, paper turned in to fulfill the requirements of IS4185 at the Navel Postgraduate School, March 1999*

has learned from previous interactions. A perfect example of this is the Earth, the earth has thousands of types of individual species (agents), each with its own rules for interacting with and adapting to its environment. Over time, species adapt to ensure they accomplish their goal, which for most, is simple survival. One of the challenges of ABS modeling is to specify agent rules of engagement such that the system as a whole will exhibit the emergent behaviors that are found in the real world.

From this description it should be apparent that ABS is essentially bottom-up versus top-down simulation. One such example of this is the Sugarscape Model which applies agent-based computer modeling to the study of human social phenomena, including trade, migration, group formation, combat, interaction with an environment, transmission of culture, propagation of disease, and population dynamics.[18] Joshua Epstien and Rob Axtell, two researchers at the Brookings Institution in Washington, D.C. created the Sugarscape model in order to conduct the kinds of repeatable, controlled experiments that natural scientists take for granted when trying to understand and create theories of physical and engineering systems. They decided to "grow" a social order from scratch to look at the social

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[18] Epstein, J.M. and Axtell, R., *Growing Artificial Societies, Social Science from the Bottom Up,* p.2, Brookings Institution Press, 1996

phenomena listed above.[19] They accomplished this by creating an ever-changing environment and a set of agents who interact with each other and the environment in accordance with simple rules of survival. Epstein remarks about social problems, "You don't solve it, you evolve it."[20]

The environment that they created was a simple landscape with one natural resource, sugar. Each location on the landscape had time-varying concentrations of sugar (a food resource). Interacting agents were represented graphically by a single colored dot. Each individual had a unique set of characteristics; some fixed, like gender, visual range for food detection, and metabolic rate, whereas others were variable like health, marital status and wealth. The behavior of these agents was determined by a simple set of rules that constitute nothing more than common sense rules for survival and reproduction, e.g., find the nearest food, eat enough to maintain your metabolism, and save the rest. What Epstein and Axtell found was with a few simple attributes and rules complex behavior such as trade and combat will emerge.

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[19] Casti, John L., *Would-be Worlds: How Simulation is Changing the Frontiers of Science*, p.171, John Wiley & Sons, Inc. 1997

[20] Ibid.

3. Components of Agent-Based Simulation

a) Agents

As the Sugarscape example shows, the three basic components of agent-based simulation are agents, an evironment and rules. Agents are simple software objects, which may represent people or organizations in our artificial society. Each agent has internal states and behavioral rules.[21] The two major characteristics of agents found in agent-based simulations are their ability to interact with their environment, and through learning, their ability to adapt future behavior based on these interactions. In the Marine Corps, agents could be individual Marines, weapons systems, units, etc. Some agents' states are fixed for the agents' life, while others change through interaction with other agents or with the external environment. For example, fixed attributes might be characteristics such as race and gender which will not change however, an individual Marine's decision to stay in or leave the military may be affected by the economy (the external environment). Furthermore, a Marine's desire to stay or leave can be affected by his or her interaction with other Marines or by which unit or occupational specialty he

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[21] Epstein, J.M. and Axtell, R., *Growing Artificial Societies, Social Science from the Bottom Up*, p.4, Brookings Institution Press, 1996

or she is in, thus, the Marine may "learn" things that would change his or her behavior. An agent typically has a goal, as in the Sugarscape model where the objective is simple survival or collecting the most sugar. For an individual Marine, the objective could be survival in a combat situation, or perhaps promotion in the personnel world.

b) Environment

The agents that make up our society must interact within some form of environment. Such an environment can be a landscape as in the Sugarscape model or some topography as in a combat situation, or it may be a more abstract structure such as a communications network or an organization. "The … 'environment' is a medium separate from the agents, on which the agents operate and with which they interact."[22] There are many software programs that provide the environment in which these software agents can interact. One such program is the Synthetic Environment for Analysis and Simulation (SEAS) described in section D below.

c) Rules

Finally, there are rules of behavior that software agents must follow. There are three basic types of rules, those that govern agent-agent, agent-environment, and

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[22] Ibid.

environment-environment relationships. Agent-agent rules govern how agents interact with each other. Some relationships, such as mating, combat, trade, etc.[23] may be specified in the code. For example, we may have a rule that says if two agents are next to each other and they are of opposite sexes they will mate and produce offspring, but only if their resource levels are greater than their combined metabolism.

Agent-environment rules govern how agents interact with their environment. These rules can be as simple as "move forward", "look in each direction to find food", "move to the closest food", and "eat food". Obviously, a corresponding environment would have to be programmed with some sort of topography containing some form of food resource for these rules to be effective.

Environment-environment rules govern how environments interact with one another. For example, the amount of food in an area might be dependent on how much food is in an adjacent area. All three types of rules may be present and active in an agent-based simulation.

4. Emergent Behaviors of Agent-based Simulation

Once agents have been identified and rules specified, we then release the initial population of agents or agent-

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[23] Ibid.

objects into our simulated environment, and observe which patterns appear or emerge. We hope that this emergent behavior provides us with insight and or useful views of comparable behavior patterns that might emerge in real-world systems. Simulations model a wide spectrum of real-world systems from the static to the chaotic, with complexity or complex systems having elements of both and therefore, falling somewhere in the middle. For example, a ballistic computer on a tank is a static simulation; it uses deterministic equations to determine the effects of wind velocity, range, elevation, propellant charge and determines a firing solution with a set probability of kill (PK). There are many variables that go into a ballistic model but the outcome is fairly static, a tank crew will hit its target within a certain PK. At the other end of the spectrum is weather prediction. It too uses deterministic equations to predict the outcomes of the interaction of many variables, but these predictions are much less static and have a great deal of randomness within them, in the form of chaos. It is the modeling of this complex world that ABS attempts to capture.

Emergence which happens in complex, as opposed to static or chaotic environments, can be the surprise-generating mechanism within ABS. It is what creates the

"Aha" experiences, those that surprise the researcher, and thereby provide insight into the situation being modeled. This is one of the greatest benefits of ABS. Although we have coded our agents with rules that govern their actions with each other and the environment, it is the very adaptive nature of ABS that causes unexpected, emergent behaviors to arise. Here is an example of emergence in nature:

> Like human societies, ant colonies achieve things that no individual ant could accomplish: Nests are erected and maintained, chambers and tunnels excavated and territories are defended. All these activities are carried on by individual ants acting in accord with simple, local information; there is no master ant overseeing the entire colony and broadcasting instructions to the individual workers. Somehow each individual ant processes the partial information available to it in order to decide which of the many possible functional roles it should play in the colony.[24]

The goal of ABS is to develop the agents and rules that guide the behaviors in a similar manner to the ants example above. As a researcher one must make many choices concerning agents, their attributes and the rules that govern their behavior. Another essential decision is how are we going to model/simulate the environment. One such program that can be used to model market-driven environments

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[24] Casti, John, L., *Would-be Worlds: How Simulation is Changing the Frontiers of Science*, pp. 91-92, John Wiley & Sons, Inc., 1997

is the Synthetic Environment for Analysis and Simulation (SEAS).

D. SYNTHETIC ENVIRONMENT FOR ANALYSIS AND SIMULATION(SEAS)

As the use of ABS grows, more and more computer software developers are creating software packages designed to assist researchers in creating agent-based environments. One such package is called SWARM, created at the Santa Fe Institute by Chris Langton. SWARM aims to provide researchers with a standardized, flexible, reliable, set of software tools for experimenting with complex adaptive systems.[25] The principal goal of the SWARM system is to relieve researchers of the burden of having to deal with computer-science issues arising in the construction of large-scale computer simulations. SWARM's strength lies in its adaptability to create many different environments, from two-dimensional planar worlds to the more physically abstract graphs representing a communications network. This strength is also a drawback when trying to model a specific form of CAS, like one that is market-driven because it lacks the specificity to account for the numerous relationships present in the marketplace. Also, SWARM does not allow for human players to interact with agents. There are several other types of software packages available for use in

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[25] Ibid. p. 180

creating ABS, e.g., BAMBOO[26], but two main drawbacks of these packages they do not focus on market-driven environments, and they cannot support agent-human player interaction.

The Synthetic Environment for Analysis and Simulation (SEAS) is an agent-based simulation environment developed at Purdue University over the last five years. When compared with other ABS packages it is relatively mature. SEAS combines elements of computable general equilibrium model, experimental economies, and distributed interactive simulation. SEAS has been used to simulate both the telecommunications industry and computer industries and has been used in two Proof of Principle exercises by the DoD. One Proof of Principle exercise was conducted in December 1999 for the Acquisition community and the other conducted in January 2000 for the U.S. Army called Firm Handshake. Firm Handshake will be covered in greater detail in Chapter 4. The SEAS environment is conceptualized in Figure 2.5 below. This environment provides a simulated economy with fully functioning goods, labor, asset, bond, and currency markets. Groups of players, usually executive decision-makers, act as

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[26] Boyd, M.A. and Gagnon, T.A., *Methodology and Design of Adaptive Agent-Based Simulation Architectures for Bamboo or Visual C++,* Masters Thesis, Naval Postgraduate School, Montery, California, March 1999

households, firms, management consultants, and government regulators.

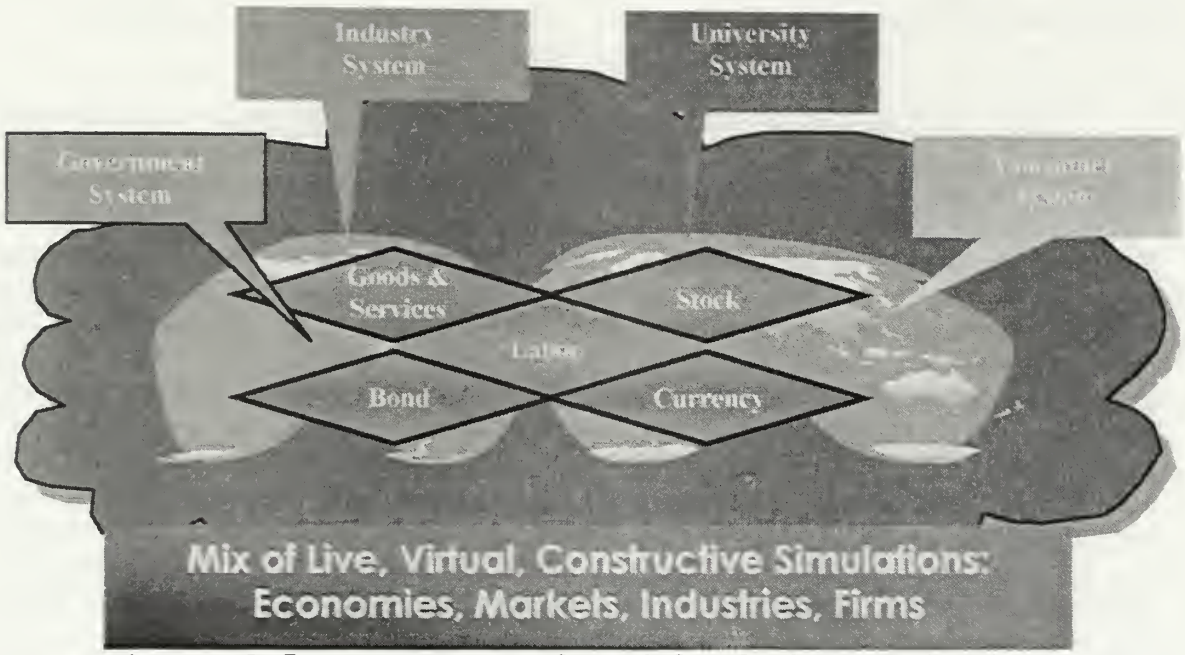

Figure 2.5 -- Conceptual Model of the Synthetic Economy for Advanced Business

In this synthetic environment/economy households are endowed with demand functions, firms with production functions, management consultants with information, and government with laws. We induce strong incentives for players to make good decisions by linking some form of reward to their performance in the economy. The simulations are designed to resemble as closely as possible the industry in the field, which can lead to experiential learning for the participants. To achieve this replication of the actual economy, extensive research and data collection and extraction are necessary (Figure 2.6).

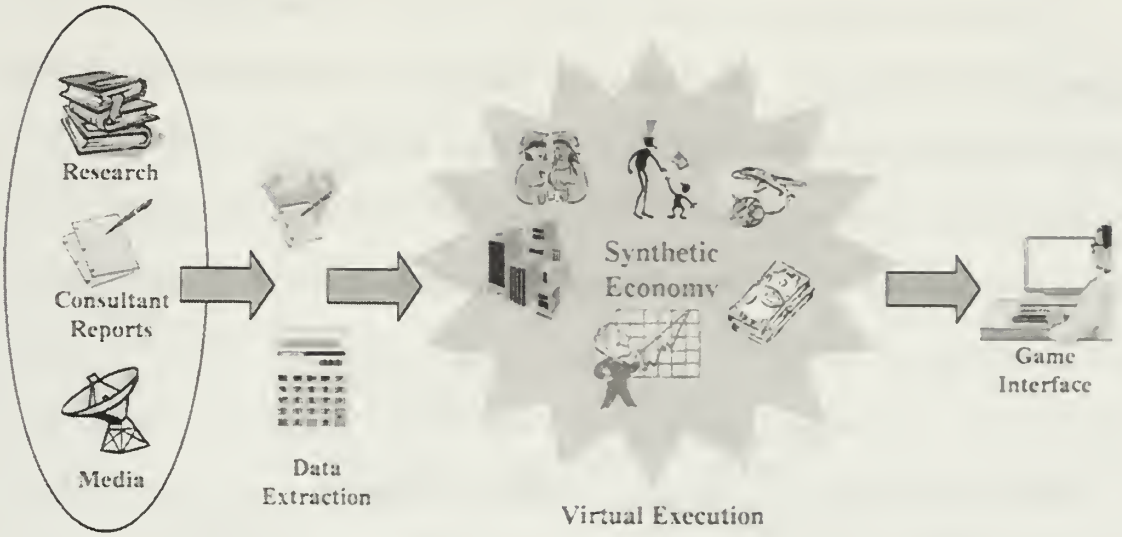

Figure 2.6 -- Development Process of the Synthetic Economy

SEAS allows replication, permitting players to learn, to identify successful and unsuccessful strategies, and to study the likely consequences of hypothetical events, such as technological innovations, changes in laws, or the entry of firms into an industry.

For military manpower applications SEAS must be adapted to focus primarily upon the labor market, concentrating upon factors that impact the market for new recruits, as well as those factors that impact active service members who are considering leaving the military to return to civilian status and/or join the reserve.

One significant advantage of SEAS over other agent-based environments is that it allows interaction between human players and the agents in the synthetic environment. To better understand how SEAS accomplishes this, Figure 2.7 shows a schematic of the technical architecture of SEAS.

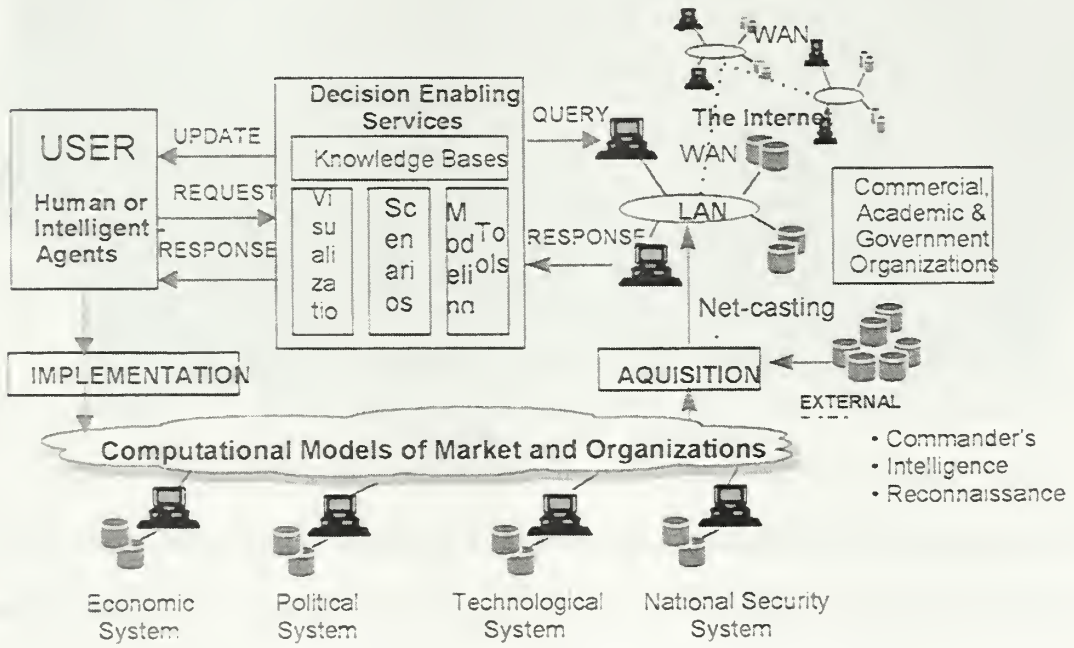

Figure 2.7 -- SEAS Architecture

Other features that SEAS provides include:

- A realistic graphical simulation of the economy.
- Integration of scientific visualization techniques, with an emphasis on interaction and multi-resolution display.
- Shared, collaborative multi-user interaction.

- Support for distributed computation on network clusters.
- A suite of multimedia tools for support of teamwork from multiple remote locations connected to a network.

Additionally, a web-based version of SEAS will be available soon. This feature will be particularly important for military organizations separated geographically. The web-based version may save significant time and money by allowing these dispersed groups to play and interact across the web.

Agent-based simulation in general, may be a cost effective way to model complex systems. We create an environment, then populate that environment with individual software agents that represent individuals, organizations, etc. We then define rules for how agents interact with their environment and each other. We also define the rules that govern environment-environment interactions. We then expect to see certain behaviors, based on the rules, but we also look for the unexpected or emergent behaviors. These are behaviors that provide analysts with greater insight into the complexity of their models. Agent-based modeling provides a platform where those unexpected behaviors can emerge.

E. SUMMARY

We previously identified six necessary activities that DMSO identified in order to meet its vision (Figure 2.2) of providing readily available, operationally valid environments for use by DoD components. One of these activities is to develop new technology within the modeling and simulations arena. DMSO also conducted an assessment of current M&S activities and identified six objectives that needed to be met in order to realize their vision (Figure 2.3). The fourth objective is to provide authoritative representations of human behavior. Through the use of agent-based simulation we can support both the activity of developing new technology and the objective of representing human behavior and present unique opportunities for capturing complex behavior in a bottom-up fashion. We will next discuss how this has been accomplished in the Firm Handshake exercise, and then we use the lessons learned there to build requirements for a Marine Corps agent-based simulation.

III. OVERVIEW OF U.S. MARINE CORPS HUMAN RESOURCE DEVELOPMENT PROCESS (HRDP)

The Marine Corps Combat Development System (CDS) includes the processes and functions that produce and sustain integrated capabilities for the Marine Corps. The CDS comprises eight enterprise processes and establishes single process owners for each. The Human Resource Development Process (HRDP) is one of the eight enterprise processes of the CDS. The HRDP cuts across major Marine Corps organizational boundaries (Manpower and Reserve Affairs (M&RA), Plans, Policies & Operations (PP&O), Aviation, Installations & Logistics (I&L), Programs and Resources (P&R), Command, Control, Communications, Computers, and Intelligence (C4I), Marine Corps Combat Development Command (MCCDC), and Marine Corps Systems Command (SYSCOM)). The Commandant of the Marine Corps (CMC) has identified the Deputy Chief of Staff (DC/S), Manpower & Reserve Affairs (M&RA) as the HRDP single Process owner. Appendix A shows the organizational charts for the Marine Corps commands that comprise the CDS process. Figure 3.1 shows a schematic of the manpower system. Each portion of the manpower system will be covered in detail.

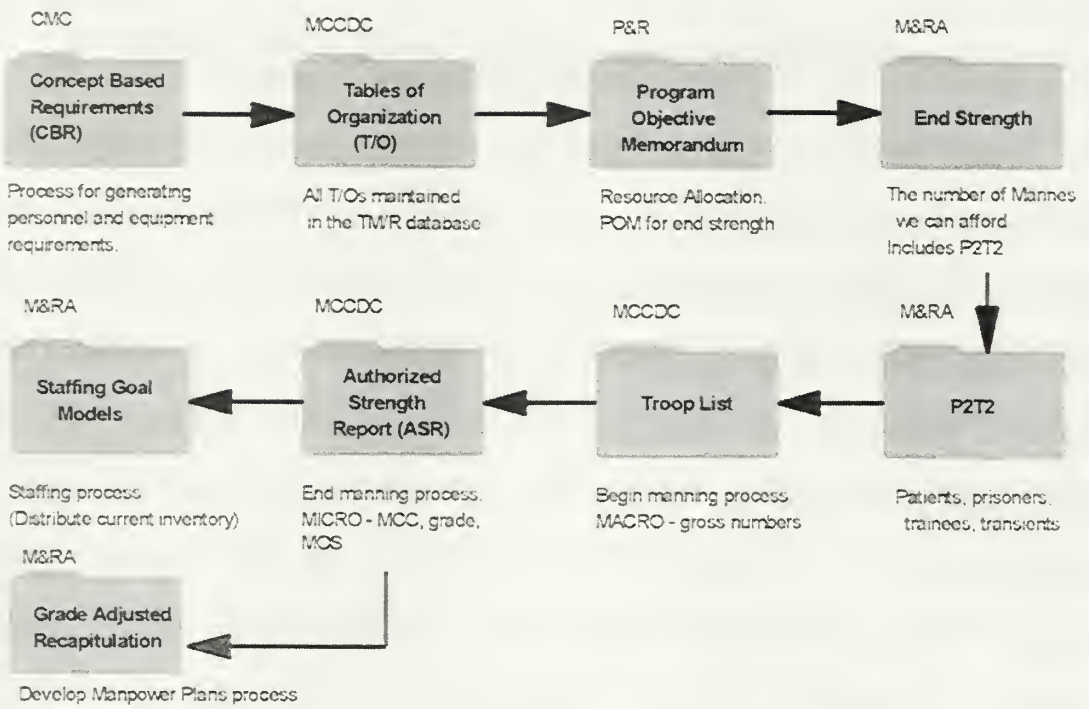

Figure 3.1 -- The Manpower System

This chapter will cover the three main areas of the Marine Corps' Human Resource Development Process (HRDP): Manpower, Recruiting, and Training. The manpower section includes the objective of the manpower process, how manpower requirements are generated, how those requirements are filled through the manning and staffing process, how plans are developed to meet the future manpower needs of the Marine Corps, and Measures of Effectiveness (MOE's) for the manpower process. The recruiting section covers the objective of recruiting, the organization of recruiting, provides a quick overview of the recruiting process, and then identifies recruiting MOE's. The training section

describes the objective of training, an overview of training progression which includes Initial Entry Training (IET), Specialized Skill Training (SST), and Professional Development Education (PDE) for both officers and enlisted personnel, and training MOE's.

A. THE MANPOWER PROCESS

1. Objective

The objective of the Marine Corps manpower process is to provide the appropriate number of trained and experienced Marines to the commander to perform their mission. The DC/S M&RA is vested with this responsibility of providing, "the right Marine, at the right time, at the right place, with the right skills."[27] It is evident by this objective that the HRDP cuts across many functional boundaries. One must realize that there are two inherent problems that constrain this objective: budget resources do not allow us to afford all the Marines we require, and available Marines may not have the right grade, Military Occupational Specialty (MOS), training, etc. to meet the requirements. These two problems underlie the inherent complexity of the system.

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[27] Habel, Gregg, T., *Manpower 101 Brief,* Presented at the Naval Postgraduate School, 22 October 1999

2. Requirements Generation/Resource Allocation

The Commanding General (CG), Marine Corps Combat Development Command (MCCDC) is the Combat Based Requirements Process (CBRP) owner. The CBRP generates requirements for personnel and equipment. These requirements are developed through experimentation, Marine Corps' Lessons Learned (MCLLS), fleet operational needs statements, and mission area analysis. The DOTES (Doctrine, Organization, Training & Education, Equipment, and Support/Facilities) group under the CBRP establishes the baseline for current and future requirements (Figure 3.2).

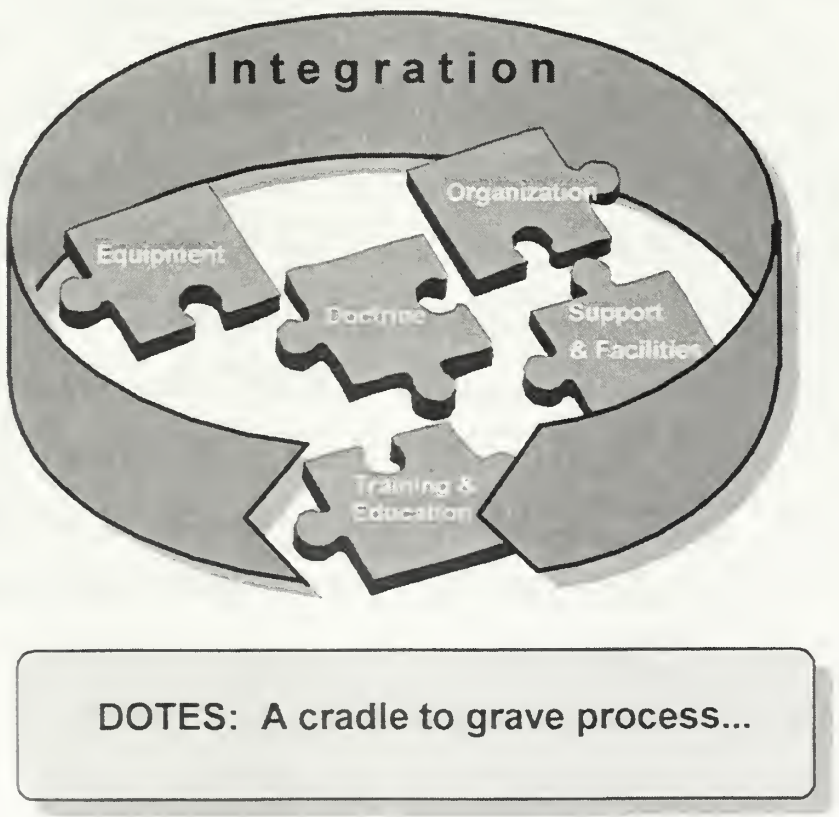

Figure 3.2 -- The DOTES Process

From the DOTES process the requirements for Marines by grade and skill are published in the form of Tables of Organization and Equipment (T/O&E) also know as T/O's. The T/O&E's prescribe the mission statement, organizational structure, billet description (grade and MOS), and personnel strength (see appendix C for an example of a unit T/O&E). In FY98, there were 153,230 T/O structure spaces in the Marine Corps.[28]

Once requirements are determined and T/O&E established, resources must be allocated to meet these requirements. Since the Marine Corps' budget is constrained, priorities are established and resources allocated through the Program Objective Memorandum (POM) process. Presently, the manpower account is the largest appropriation, and consumes 61 percent (approximately $7 billion) of the total Marine Corps' budget. Figure 3.3 shows a breakdown of the Marine Corps budget for FY00 by percentage.

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[28] Ibid.

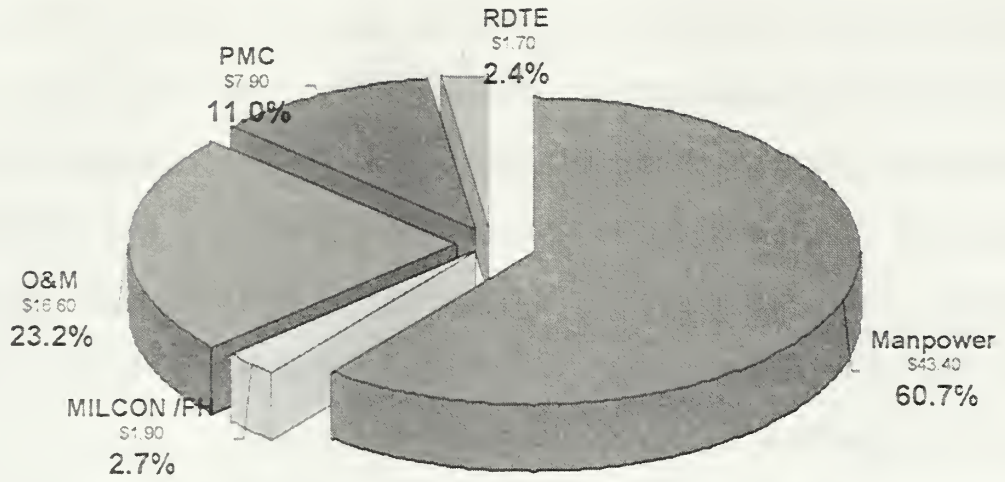

Figure 3.3 -- Marine Corps FY00 Budget Breakdown[29]

The Marine Corps "POM's" for end strength every two years. The POM encompasses an eight-year planning horizon, e.g., FY00 is the current year, FY01 is the budget year, and FY02-07 are the POM years. Marine Corps' end strength is determined and fixed within the POM. The POM injects fiscal reality into the manpower process. Based upon our prioritization of resources and the POM process, Congress sets the Marine Corps' end strength with an end strength floor and ceiling of plus or minus 1 percent. On September 30th of each year Marine Corps active duty end strength must fall within this target. For FY00 the end strength target for the Marine Corps is 172,200.[30]

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[29] Ibid.

[30] Ibid.

The DOTES process has determined that the Marine Corps requires approximately 154,000 personnel to meet all of its requirements, and that our end strength target is 172,200. It would appear that we can afford all the Marines necessary, and that in fact, we have a surplus of resources. This is misleading, since there is a cost of doing business called Patients, Prisoners, Trainees, and Transients (P2T2) that has not been accounted for. P2T2 is a DoD-mandated measuring tool that accounts for Marines not assigned to billets or structure spaces. P2T2 includes patients hospitalized for more than 30 days, prisoners incarcerated for greater than 30 days but less than six months, entry level accession training or training in excess of 20 weeks, and transients (Permanent Change of Station (PCS), access, train, operational, rotational, separation). For Example, the T/O&E at the Marine Corps Recruit Depots (MCRD's) in San Diego, CA and Paris Island, SC, contain T/O&E billets for Drill Instructors and Series Commanders but not for the recruits that they train. In FY00, P2T2 is estimated at 29,042, approximately 80 percent of which is comprised of trainees.[31] So taking an end strength figure of 172,000 and subtracting a P2T2 figure of 29,000 leaves 143,000 Marines

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[31] Ibid.

available for 154,000 T/O&E billets. Table 3-1 shows the requirements vs. reality of the resource allocation process.

	OFFICERS	ENLISTED	TOTAL
BUDGETED STRENGTH	17,878	153,550	171,428
P2T2	3,407	25,635	29,042
AVAILABLE MANNING	14,471	127,915	142,386
T/O	16,192	137,989	154,181
DELTA	-1,721	-10,074	-11,795
MANNING %	89.37%	92.70%	92.35%

Table 3-1 -- Requirements vs. Reality[32]

3. The Manning Process

The manning process determines which structure spaces the Marine Corps intends to put Marines into, or "man". It is important to remember that manning is about billets and not people. Since the Marine Corps cannot "afford" to buy all of the Marines to man the requirement of approximately 154,000 T/O&E structure spaces, manning becomes a challenging exercise to designate the appropriate billets. The manning process has three principal inputs, T/O&E's, end strength, and P2T2, and two principal outputs, the Troop List and the Authorized Strength Report (ASR).

The first manning process output is the Troop List, which determines how many officers and enlisted Marines a unit is allocated each year of the POM planning horizon. The Troop List does not list the Marine's grade or MOS, but

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[32] Ibid.

only provides gross numbers, e.g., Unit X will be manned with Y officers and Z enlisted Marines. The billets we can afford are then allocated between the supporting establishment (SE), the ground combat element (GCE), the aviation combat element (ACE), the combat service support element (CSSE), and the command element (CE). Figure 3.4 shows this breakdown for FY98.

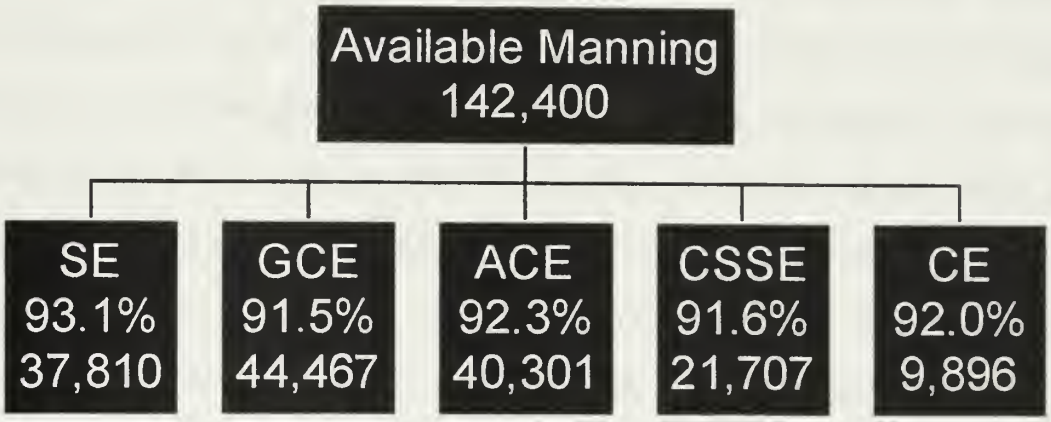

Figure 3.4 -- Manning Percentages by Element

Figure 3.4 shows the target fair share manning percentage that each element should get, as policy though, the Marine Corps mans the supporting establishment (SE) at 100 percent. This means that there is less remaining to be allocated among the other four elements.

The last part of the manning process is the Authorized Strength Report (ASR), which completes the manning process. The ASR converts the macro level Troop List into the micro level of detail. Specifically, the ASR allocates manning to

units by grade and MOS, recalling once more that manning is about billets, and not people. The ASR lists how many of the T/O&E billets can be filled by grade and MOS but not at the specific billet level. For example, if an infantry battalion is given only five captains (O-3's) with an infantry MOS (0302) but rates six by T/O, the ASR does not tell us which ones will be manned and which one won't. The ASR is delivered to the Manpower Management (MM) division of M&RA to staff the billets (put a person with a billet) and to the Manpower Plans (MP) division of M&RA to develop future plans for the manpower inventory. The ASR links requirements generation through DOTES (done by CG, MCCDC) and the HRDP (done by M&RA).

4. The Staffing Process

MM strives to match current inventory with the manning levels identified in the ASR. Once the MM division receives the ASR, they begin the staffing process. This process can be considered as the "distribute current inventory process". The staffing process fills the billets identified in the manning process with actual Marines. Within the MM division, there are two sections, Manpower Management Officer Assignments (MMOA) and Manpower Management Enlisted Assignments (MMEA), which use the ASR. MMOA and MMEA run staffing goal models based on the ASR. The staffing goal

models take the current inventory of Marines and match as best as possible the inventory with the billets that the ASR has authorized.

Much of the friction involved in the manpower process rests with the inability to "staff" all of the billets that have been determined should be manned. There are many factors that cause this to happen, e.g., we may have determined in the ASR that all 24 Infantry Battalions should be manned with a Gunnery Sergeant (E-8) Supply Chief (MOS 3042). DC/S M&RA then directs the MMEA division to assign Marines to staff those billets. The problem arises when the current available inventory does not have enough Marines of that grade and MOS to assign to those billets. In that case, MMEA would either assign someone of lesser grade, or of a different MOS, or not fill the billet at all. It is akin to fitting a round peg into a square hole.

Since the current inventory will never match the requirement and because all units are not created equal, the Marine Corps has established a staffing precedence which, similar to the POM for financial resources, prioritizes and allocates the staffing of Marines to authorized billets. Staffing precedence is necessary to accommodate operational needs, CMC policy, and the mismatch between available

inventory and requirements. Table 3-2 is the current staffing precedence structure.

Staffing Precedence Structure			
Type	***Percent of Manning***	***Unit Types***	***Notes***
Excepted Commands	100% Manning by Grade and MOS	SE, HMX-1, Marine Corps Recruiting Command (MCRC)	MCRC receives 107% of T/O
Priority Commands	100% Manning, Grade and MOS substitutions allowed	All "Victor (V)" Units	V units are all deployable units, e.g. an infantry battalion
Pro-share Commands	Manning level based on remaining inventory after excepted and priority commands are manned	Non-Victor GCE and CSSE units	None

Table 3-2 -- Marine Corps Unit Staffing Precedence Structure

5. Future Plans Process

Whereas the MM division conducts the staffing process, MP division attempts to grow a future inventory of Marines to match the requirements outlined in the POM. This process is also known as the "Build Future Inventory Process". Plans are developed to "grow and shape" the inventory to meet inventory requirements. The inventory development process consists of accession plans, classification plans, promotion plans, training plans, and retention plans. The

whole process centers on the Grade Adjusted Recapitulation Report (GAR). The major inputs to the GAR are end strength, P2T2, and the ASR. The manpower planners use the GAR numbers as targets to develop the various plans mentioned above. These plans are then delivered to the MM division, MCRC, and Training & Education (T&E) for execution.

6. Measures of Effectiveness

As with any system, we must have some measure of how well the system is performing. The Status of Resources and Training System (SORTS) report is DoD's method to measure effectiveness of the manpower system. SORTS uses a personnel readiness index (P-Rating) based upon the reporting unit's T/O. Table 3-3 shows the definitions of P-ratings in terms of percent of unit T/O.

SORTS READINESS MEASUREMENT (P-Rating)	
P-Rating	*Definition in terms of Percent of T/O*
P-1	90% <= T/O <= 100%
P-2	80% <= T/O <= 89%
P-3	70% <= T/O <= 79%
P-4	T/O < 70%
P-5	Unit standing up or standing down

Table 3-3 -- SORTS Readiness Measurement (P-Rating) Definition

Based on the discussion above one must realize that very few units will ever be allocated enough manning to equal their T/O, due to scarce resources.

- Other Measures of Effectiveness (MOE's) that M&RA uses to track mission accomplishment/performance include tracking end strength, P2T2, unit precedence levels, and manning costs. Within the SimMarineCorps business wargame these MOE's will be used to determine the effects of the actions that each team takes. One MOE for readiness should mirror the P-rating system of SORTS. Although not ideal for reasons mentioned earlier, most Marines are familiar with the P-rating scale of SORTS.

Available data/metrics for manning are listed in Appendix D.

B. RECRUITING

1. Objective

Marine Corps Recruiting Command (MCRC) states, "Our mission is *to locate, close with, and enlist* the highest quality Marines for the Corps of the 21st Century."[33] This mission has increasingly become one of the most difficult enterprises within the manpower process. There are many factors that influence this: strong economy, tight labor market, growing cultural gap between military and civilians, etc. One thing is certain, however, recruiting is not going to get any easier. Recruiting is strongly influenced by market forces, and is therefore, especially well suited for being modeled in an agent-based simulation.

The pressures on recruiting began with the drawdown in the early 1990's, with a brief surge during the Persian Gulf War. To meet these growing pressures, the Marine Corps established MCRC in 1994 for three reasons:

1. It established a Commanding General for MCRC rather than a staff officer at HQMC, M&RA.
2. It gave recruiting direct access to the Commandant of the Marine Corps (CMC).

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[33] Marine Corps Recruiting Command (MCRC), *Building a Corps for the 21st Centrury,* MCRC Command Brief, November 1999

3. It achieved unity of command for the recruiting mission.

MCRC's underlying philosophy is as follows:

- We make it (recruiting) a priority.
- We assign our best people (to recruiting).
- We recruit what we are.
- We empower them (recruiters).
- We recognize achievements, contributions, and sacrifices (of recruiters).[34]

2. Recruiting Organization

To achieve its mission MCRC is sub-divided into two regions (east and west), with each region sub-divided into three districts (1st, 4th, and 6th districts in the east and 8th, 9th, and 12th districts in the west). Within the six districts there are a total of 48 recruiting stations, geographically dispersed to achieve maximum coverage of the available population (Figure 3.5).

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[34] Ibid.

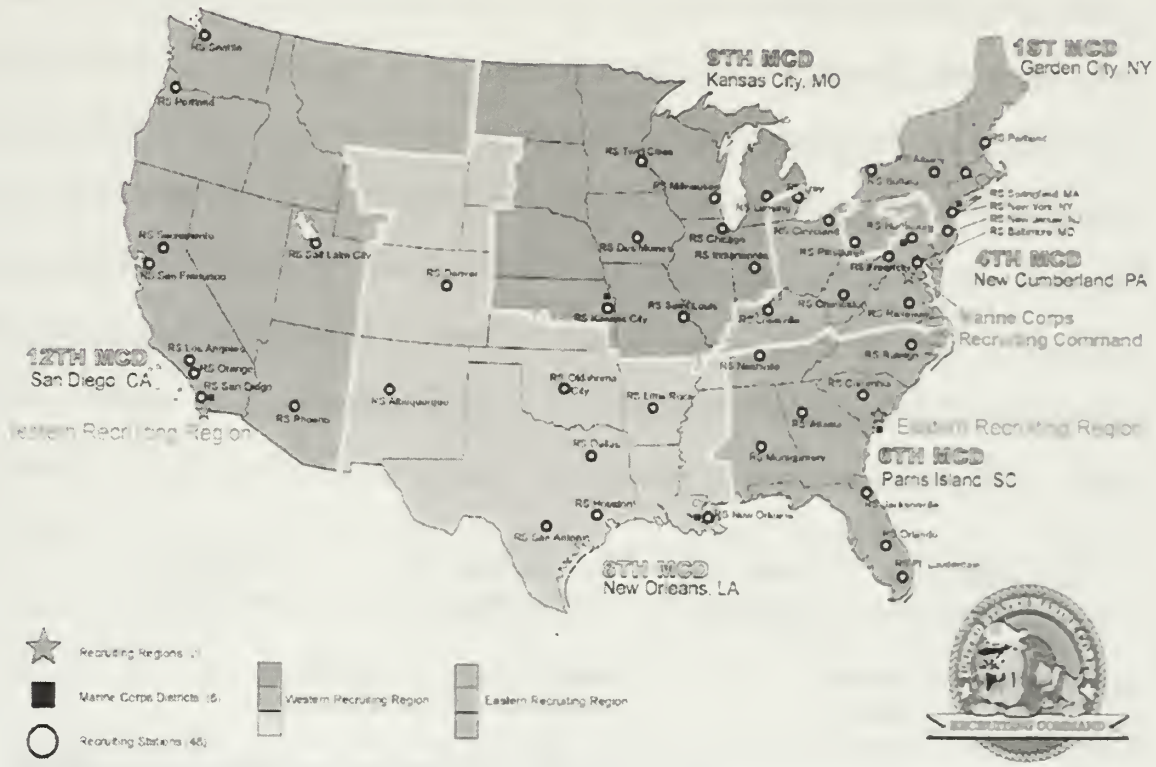

Figure 3.5 -- Marine Corps Recruiting Command

Each district is commanded by a command screened Colonel (O-6), and each recruiting station is commanded by a Major selected by a board held at HQMC. Also, each district and recruiting station has a Sergeant Major (E-9) assigned to it. Every recruiter is screened and interviewed prior to assignment as a recruiter. This organization represents a significant commitment of resources to the recruiting effort. With the recruiting climate becoming increasingly

difficult, we can safely assume that this commitment will increase.

3. Process Overview

The predominant market for new military recruits is the high school senior, which makes recruiting a formidable challenge. High school graduates have a wide variety of choices available concerning their future: they can go to college, get a job, get a part-time job and go to college part-time, join the military, etc. Figure 3.6 shows how MCRC views the marketplace.

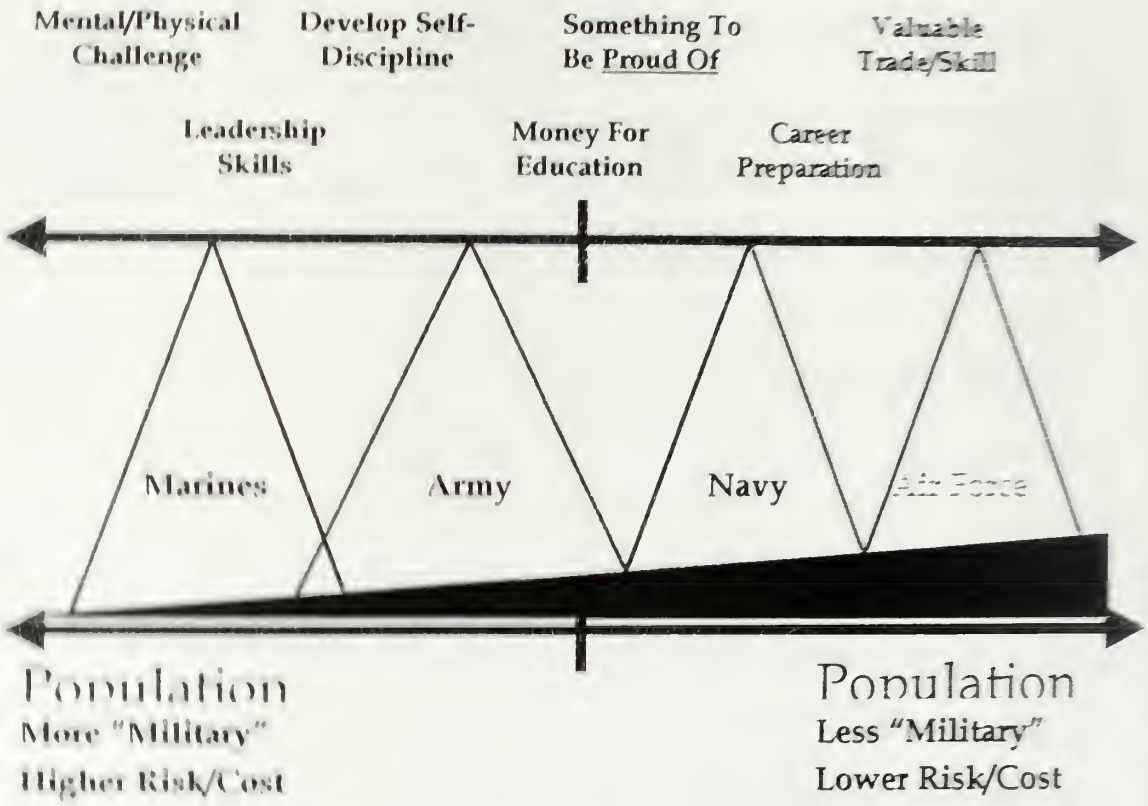

Figure 3.6 -- MCRC Recruiting Market Place Model

To further explain figure 3.6, the traits listed across the top are those aspects that potential recruits are seeking when they join the military, and are listed above the service that is most identified with those traits. The population graph at the bottom projects the level of population that is seeking these traits and therefore estimates a level of difficulty of recruiting for each of the respective services.

Once contacted a potential recruit will first take the Armed Services Vocational Aptitude Battery (ASVAB) test. Upon completion of the test a potential recruit is placed into a mental category (I-IIIA, IIIB, and IV) based on the Armed Forces Qualification Test (AFQT). If an applicant scores an AFQT of at least ten s/he can be scheduled to take a physical. It is important to note that the lowest mental category IV requires an AFQT of 36. Upon completion of a physical an applicant then goes through a moral screening including a background check, finger printing, and interview. All of the above processes occur at a Military Entrance Processing Station (MEPS) which is a completely different command than recruiting. MEPS are tasked with ensuring that all applicants enlisted in the military are mentally, morally, and physically qualified. If an applicant passes all of these hurdles, s/he then returns his

or her respective service for job assignment and contracting. In general, when applicants enlist, they enlist into the Delayed Entry Program (DEP), where they either remain until they ship to boot camp, or else attrite from the DEP.

4. Measures of Effectiveness

The primary measure of effectiveness for both enlisted and officer recruiting is meeting recruiting goals. This goal is specifically the number of new recruits and officers that will attend initial entry training in the upcoming FY. Figure 3.7 shows an initial snapshot of the FY00 enlisted recruiting goal and Figure 3.8 shows the same snapshot for officers.

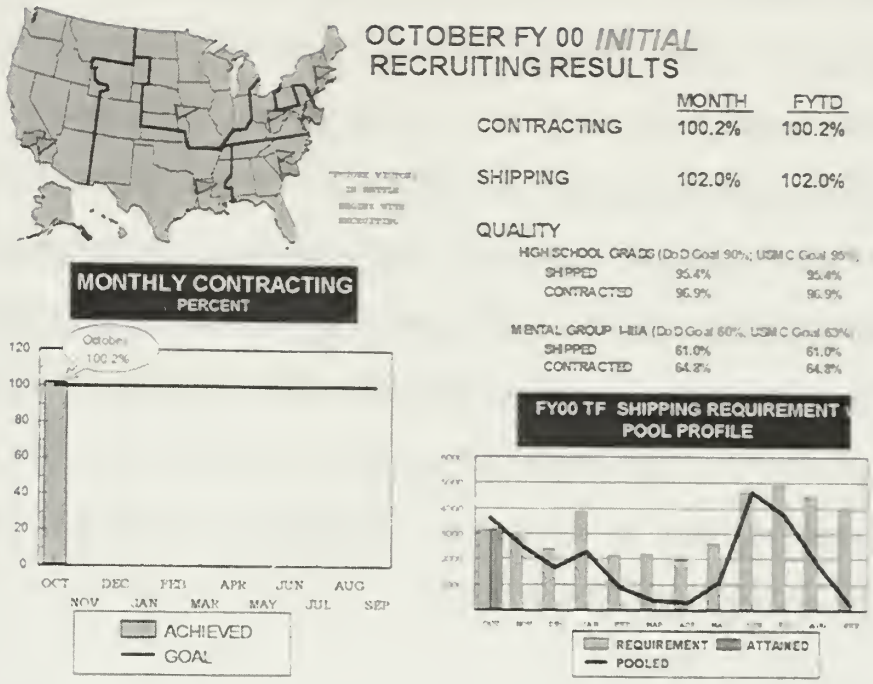

Figure 3.7 -- Enlisted Recruiting Mission FY00 Initial Snapshot

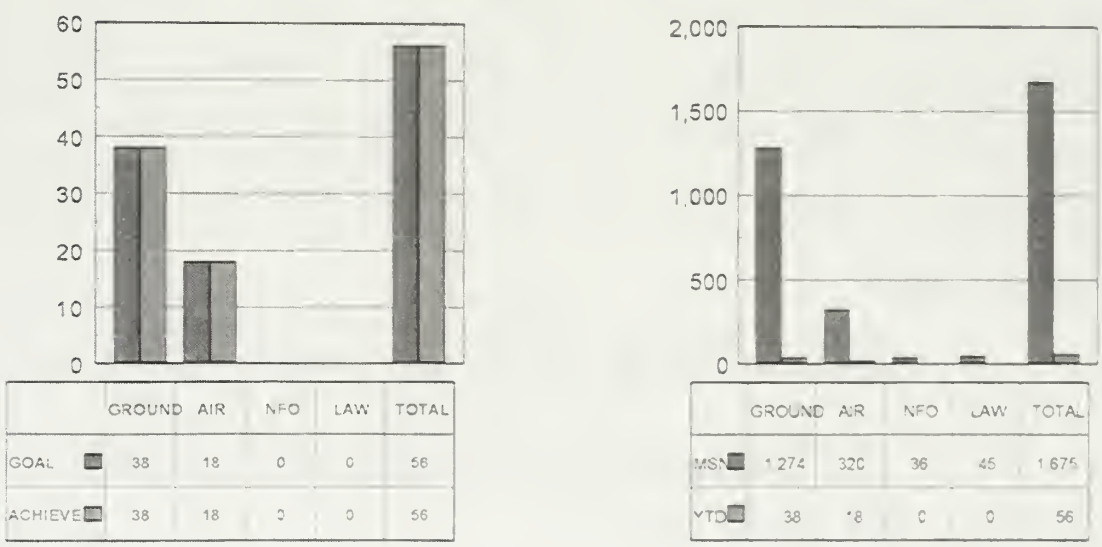

Figure 3.8 -- Officer Accession Goal FY00 Initial Snapshot

There are other MOE's that are also important indicators of success for recruiting. They include

recruiter productivity and cost per contract. Recruiter productivity is the average number of contracts a recruiter, whether officer or enlisted, completes a month. From FY1994-1999 the average monthly contract for a Marine recruiter is 1.16699, so for the year a recruiter could expect to write about 14 contracts.[35] The cost per contract is simply the recruiting budget and the cost of recruiters (accounted for in the manning budget) divided by the number of recruits/officer accessions. Available data/metrics for recruiting are at Appendix F.

C. TRAINING

1. Objective

This section will focus on the "trained and experienced" portion of the manpower system. Under the guidance of CG, MCCDC, the Training and Education (T&E) Division is responsible for the formal training of Marines. T&E's mission is to,

> Design, develop, resource, and implement formal training to provide combat-capable Marines to the operating forces and supporting establishments, and assist standardization of unit training throughout the Marine Corps.[36]

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[35] Source is Defense Manpower Data Center (DMDC) accession files for 1994-1999

[36] Training & Education (T&E) Homepage, *Mission of T&E Division*, [http://www.tediv.usmc.mil], January 2000

It is not sufficient to simply recruit the right numbers, or man or staff units to the appropriate level, the Marine Corps must also have a way to ensure that Marines are trained adequately to meet the missions assigned them. To accomplish this the Marine Corps provides three types of training, initial entry training (IET), Specialized Skill Training (SST), and Professional Development Education (PDE).

2. Training Progression

The formal training section of T&E Division uses a relational database (Oracle™) called the Training Requirements and Resources Management System (TRRMS). TRRMS is used to produce the Training Input Plan (TIP) and the Training Quota Memorandum (TQM). It is also the primary source of data for developing the Marine Corps portion of the Military Manpower Training Report (MMTR) for the DoD. Accordingly, the major training categories used in TRRMS are based on the training categories found in the MMTR. These categories are defined in the following sections.

a) Initial Entry Training (IET)

Within IET there are two types of training, recruit training (for enlisted) and officer acquisition training (for officers). Recruit training includes the introductory physical conditioning, basic military training,

indoctrination and acquisition of common skills given to all enlisted entrants. Marine Corps recruit training is 13 weeks long and is conducted at Marine Corps Recruit Depot (MCRD), San Diego, California and Parris Island, South Carolina. The training facility a new recruit attends depends on the geographic location from which they were recruited. In general, those recruited in the eastern region go to Parris Island, and those recruited in the western region go to San Diego. The exception is that all female recruits go to Paris Island.

Officer acquisition training includes all types of training leading to a commission and is conducted solely at Marine Corps Combat Development Command, Quantico, Virginia. There are two levels of IET for Officers, Officers Candidates School (OCS) and The Basic School (TBS). OCS ranges in length from six to ten weeks depending on the accession source that the officer candidate is enrolled in. OCS is designed as a screening process for potential officers. Although OCS does teach basic Marine skills, it is mainly a means to determine whether an officer candidate should be commissioned as a Second Lieutenant in the Marine Corps. All officers except those commissioned from the United States Naval Academy must complete OCS in order to enter the Marine Corps as an officer.

The second level of IET for officers is TBS, a six-month long course designed to teach all officers the basics of being an Officer. It also provides a common base for all officers regardless of MOS in the basics of being an Infantry Platoon Commander. Upon completion of IET, both officers and enlisted Marines attend some form of Specialized Skill Training (SST).

b) Specialized Skill Training (SST)

Specialized Skill Training (SST), also known as Military Occupational Specialty (MOS) training, provides officers, warrant officers, noncommissioned officers, and enlisted personnel with initial job qualification skills, or new or higher levels of skill in their current military specialty or functional area. SST is further divided into three areas: initial skill training, skill progression training, and functional training.

Initial skill training includes all formal training given immediately after recruit training or officer acquisition training. In general, initial skill training leads toward the award of an MOS. Skill progression training is any training received after initial skill training. This level of school does not have to yield an MOS but is meant to increase the knowledge and skills within a particular MOS, e.g., squad leaders school or platoon

sergeant course. Functional training is an "all other" category. It covers those types of required training that do not fit neatly into the definitions above. It may also be described as training for a specific assignment or duty position.

c) Professional Development Education (PDE)

Professional Development Education (PDE) is essential for the further development of both enlisted and officer Marines. PDE includes educational courses conducted at the higher-level service schools or at civilian institutions to broaden the outlook and knowledge of personnel or to impart knowledge in advanced academic disciplines to meet service requirements.

PDE for enlisted Marines occurs at three levels:

1. At the Non-Commissioned Officer (NCO, E-4 & E-5) level, a Marine would attend NCO School.
2. At the Staff Non-Commissioned Officer (SNCO, E-6) level, a Marine would attend the SNCO Academy.
3. At the E-8 level, the Advanced SNCO Academy.

For Officers there are also three levels of PDE:

1. At the Company Grade or career level, officers attend the Amphibious Warfare School (AWS) or one of the U.S. Army's Advanced MOS

Schools, such as, Advanced Artillery Officers Course.

2. At the intermediate level for O-4's, officers attend either the Marine Corps' Command and Staff College or other service or allied equivalent.

3. At the top level for O-5's & O-6's, officers attend the Naval War College and other service equivalents.

4. Additionally, advanced degree programs are open from both civilian institutions as well as service schools like the Naval Postgraduate School for both the career and intermediate level officer.

3. Measures of Effectiveness

The primary measure of effectiveness used by T&E division is Training Load.

[(Input + Graduates)/2]Course Length = Training Load

The following are definitions for the variables in the above equation.

- *Input:* The number of students who initially start a course.
- *Graduates:* The number of students who actually graduate from a course.

- *Course Length:* Expressed as a fraction of a year (course length in days divided by 365).

Training Load provides how many man-years are used by the respective training. This is of particular importance when determining P2T2, and has a direct impact on manning levels, and therefore, readiness. Another important MOE is training attrition rate which has an impact on training load, and, in particular the IET attrition rate which directly affects first term non-EAS attrition, and indirectly affects recruiting and retention goals. Two other measures are total number trained and total cost per trainee (Equation 3-2).

(TotTrained)/(TrainBud + InsManBud) = Cost per Trainee

The following are definitions for the variables in equation above.

- *TotTrained:* Is the total number of those who enter training.
- *TrainBud:* Total training budget.
- *InsManBud:* That portion of the manning budget allocated to paying instructors.

Available data/metrics for training are at Appendix G.

D. SUMMARY

The HRDP process described above can be considered as a Complex Adaptive System. For example, recruiting is market-driven, and we can easily apply the "NK" model, described in Chapter II, where "N" is the number of potential recruits and "K" the available options for those potential recruits (work, school, military), and the external factors that influence those options (economy, labor market, firms, universities). Recruiting is not the only area of the HRDP that is market driven; market forces also affect retention. Similar forces (economy and labor market) have a direct influence on a Marine's decision to stay in or leave the military.

The HRDP crosses across many functional areas, manpower, recruiting, and training. Actions/policies in one area can have both expected and unexpected (emergent) effects. Also, the requirements that the HRDP tries to fill are generated by the CDS and DOTES process. Limited resources and imperfect personnel matches only constrain the system further. This complexity suggests agent-based simulation as a tool to model the HRDP process.

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IV. U.S. ARMY'S FIRM HANDSHAKE PROOF OF PRINCIPLE EXERCISE

This chapter provides an overview of the U.S. Army's Proof of Principle business wargame, Firm Handshake. It describes the structure of Firm Handshake, the teams, player controls, relationships between the teams, agent relationships, and the lessons learned from the Proof of Principle Exercise.

A. BACKGROUND/OVERVIEW

Firm Handshake is a proof of concept exercise sponsored by the Naval Postgraduate School, Purdue University, and the U.S. Army's Center for Land Warfare. Its goal was to test the feasibility of using agent-based simulation to capture the interaction of certain U.S. Army manpower business processes with each other, and with external and internal labor markets. This form of simulation is commonly referred to as Business Wargaming.

Business wargaming is the management counterpart to combat simulation, where battles are fought in marketplaces rather than battlefields. This form of simulation uses bottom up, agent-based simulation wherein individuals or organizations are represented by software agents programmed with rules of engagement vice top down, discrete event approach favored by combat simulations.

This exercise was conducted over a three-day period from 23-25 January 2000. It consisted of a day for set-up (23 Jan), an exercise day (24 Jan), and a hot wash-up/debrief day (25 Jan). The set-up day was used to install and debug the software at the U.S. Army's Warfighting Analysis and Integration Center (WAIC) in Arlington, VA where the exercise was conducted. The exercise was to consist of a pre-game briefing, a trial run, and then the running of three six-year scenarios covering the period from 2000-2005. Each scenario would vary by either economic or military situation, and would comprise three two-year segments. Technical difficulties prevented the running of a complete scenario. The third day was to consist solely of a debrief of the exercise to Lieutenant General (LTG) Byrnes. LTG Byrnes is the Commanding General for the Army's Center for Land Warfare. This briefing did not occur due to inclement weather, and was subsequently rescheduled for 18 February 2000.

B. OBJECTIVE OF FIRM HANDSHAKE

Firm Handshake is a Proof of Principle business wargame focused on how various components of the Army function and interoperate under differing external circumstances. The goals of Firm Handshake are to increase participant insight and awareness into the following issues:

- *Connectivity among the various Army functional programmatic areas (e.g., recruiting, training, force structure, infrastructure, modernization);*
- *Connectivity between Army organizations/entities and external environments (e.g., the economy, the Geo-political environment, the global security environment);*
- *Implications of resources-to-readiness "pipeline";*
- *Business wargaming simulation as a policy knowledge management vehicle for a wide variety of applications.*[37]

The focus of Firm Handshake is concerned more with the process than the outcome. The intent is to uncover the tradeoffs and decisions that the various players make in the process of responding to engagements, rather than the outcome of any particular military engagement. Of particular interest is observing the effects of the tradeoffs and decisions of one player on the other players in the game.

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[37] Dolk, Daniel, R. "Firm Handshake, A Business Wargame for the Army," 24 January 2000, p. 2

C. OVERALL STRATEGIC AND GEOPOLITICAL ENVIRONMENT

One advantage of Agent-based Simulation is that the use of individual software agents can reasonably model the various markets that affect the military. These markets include the economy, labor market, industry, and the government sector. One must also understand the overall expected global environment that underlies the assumptions governing the various rules that the agents will follow. The global environment predicated for Firm Handshake is presented in Appendix H.

D. SCENARIOS FOR FIRM HANDSHAKE

The original intent of Firm Handshake was to present three scenarios to the players that vary by either economic or military conditions. Each scenario was to start in fiscal year (FY) 2000, proceed through FY 2005, and consist of three moves of two years each. Within each move, players would be able to make decisions every six months. Later in this chapter, we will look at the various player screens and see the types of decisions that players could make and influence.

The first scenario was to reflect the current military and economic environment as of January 2000. The second scenario was to incorporate various changes, both positive and negative, in the U.S. economy, with the military

situation remaining relatively stable. The third scenario was to reverse this vignette and manifest significant military developments and engagements while leaving the economy relatively stable. These scenarios were designed to test the effects of various contingencies on the Army's manpower business processes. Some of the questions the scenarios would provide insight include: How does a booming economy effect recruiting/retention? How does the rise of another military competitor effect our readiness and operations tempo (OpTempo) and thus our ability to attract and retain the appropriate numbers of people to accomplish the missions assigned to the Army?

E. FIRM HANDSHAKE STRUCTURE

Firm Handshake was designed to capture the connectivity between the six functional areas in the Army. These areas are manning, training, organizing, equipping, sustaining, and installations. The Army must have an overall strategy to integrate these functional areas effectively. This strategy will determine what capabilities are needed for the Army, what resources are available (budget, units, weapons, personnel, etc.) and how to allocate these resources. Figure 4.1 shows the structure of Firm Handshake. The green portions are those functional areas that were tested in the Proof of Principle whereas the red portions are the

remaining areas that would be developed if the Army were to go into full simulation production.

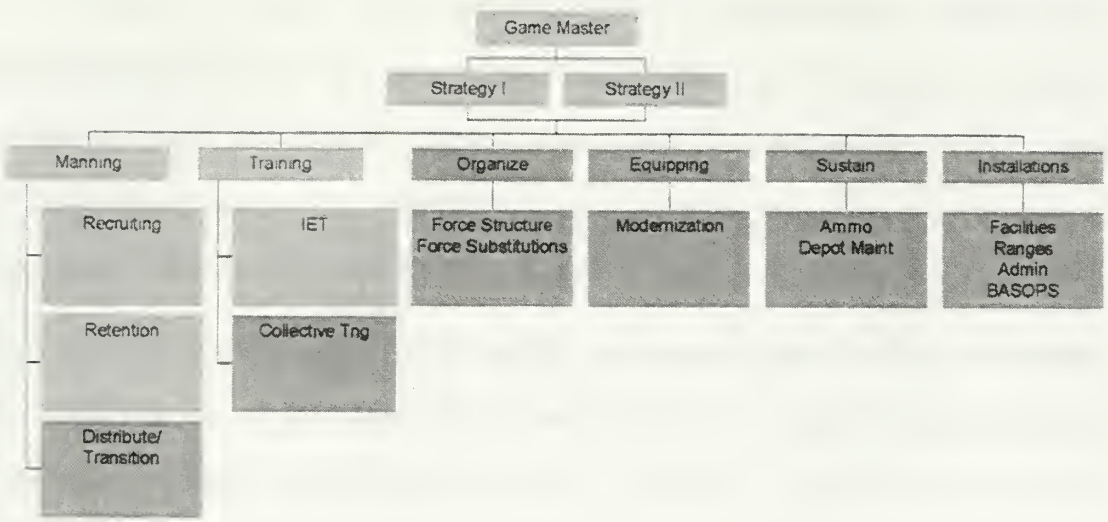

Figure 4.1 -- Structure of Firm Handshake

F. FIRM HANDSHAKE TEAMS

Each of the functional areas shown in the section above has its own corresponding team and screen(s). Some areas such as manning and training have multiple screens that break up the functional area in a logical manner. Now that we have an understanding of how Firm Handshake is structured we will look at the individual teams, what they control, the relationships they have to other screens, and the corresponding agent relationships.

1. Game Master

The Game Master in essence is not a team but a person. There is no separate game master screen. The game master in

general will work from the strategy screen, which will be discussed in detail later. The Game Master's primary responsibility is to inject events in the form of Major Theater Wars (MTW's) or Small-Scale Conflicts (SSC's). SSC's are characterized as limited conflicts or operations other than war such as disaster relief, humanitarian assistance, and peacekeeping. The Game Master will interject these events at the times prescribed by the scenario.

2. Strategy and Force Structure

a) Controls and Screens

The strategy team has two screens, which set the overall strategy of the Army in terms of warfighting capability and resource allocation. In order to get a clear picture of what the player will see and to get an idea of the player controls Figure 4.2 is a screen shot of the Strategy I screen.

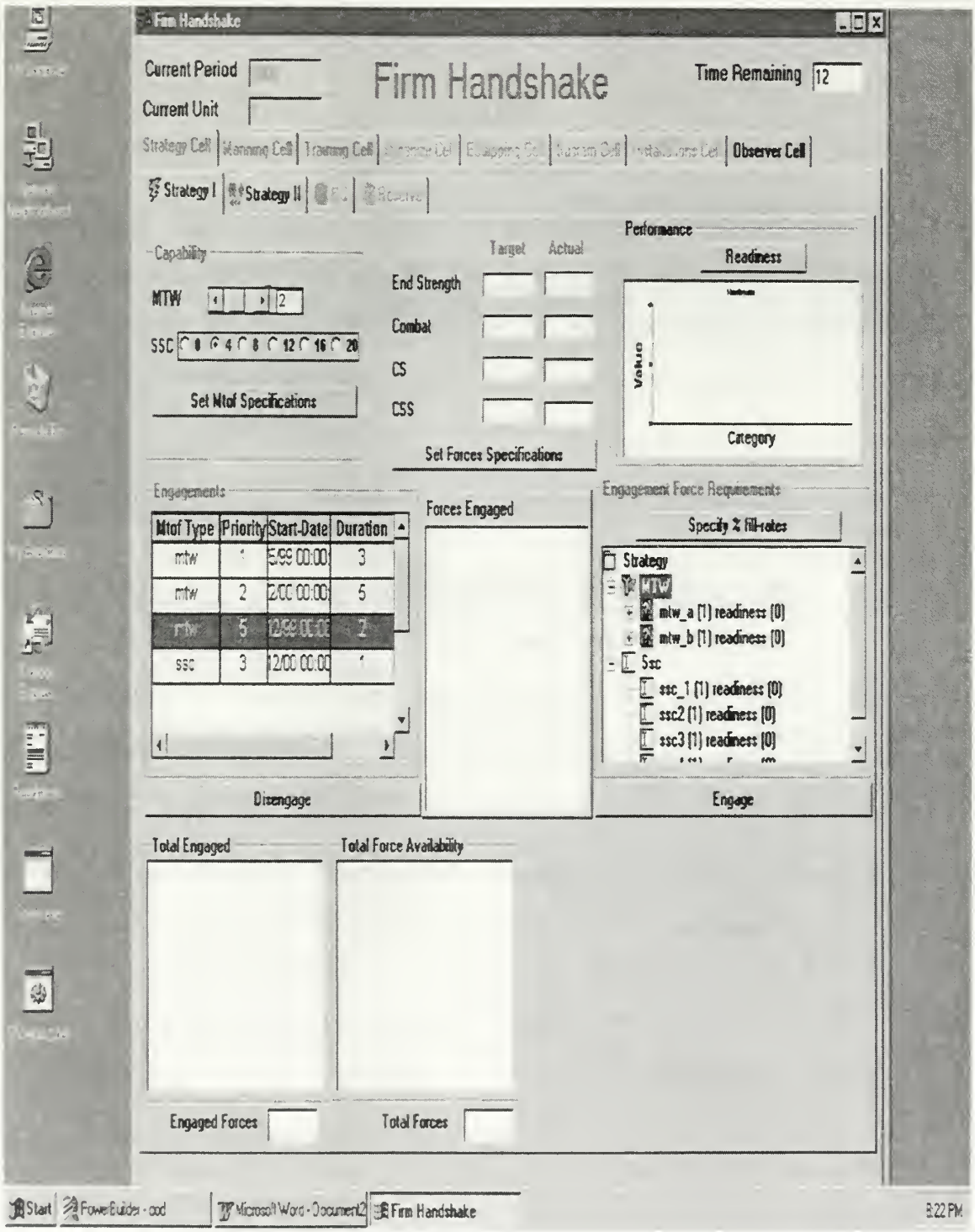

Figure 4.2 -- Firm Handshake Strategy Screen I

The players on this team control the following:

- ***Warfighting Capabilities***: The team determines the number of conflicts, either MTW's or SSC's that the Army needs to be prepared to engage in, either simultaneously or near simultaneously.
- ***Force Composition***: Once the capabilities are set, Firm Handshake determines a target end strength that will satisfy the chosen capabilities. End strength is then further broken down into combat, combat support (CS), and combat service support (CSS) units. The player can then enter either current actual end strength figures, or figures based on the scenario projected end strength.
- ***Force Allocation:*** The player then determines the fill rate for each type of conflict (MTW or SSC) by unit type (combat, CS, or CSS). This fill rate is a number from 0-100 and in general represents the minimum fill rate percentage we will accept before committing forces to the selected conflict.

Once the strategy team completes setting the capabilities on Strategy Screen I, it will move onto Strategy Screen II and set resource allocation targets. Strategy Screen II is where Firm Handshake allows team members to look at manpower policy and manpower resource

allocation. The strategy team can see the previous years funding and enter what is programmed for this year. They can set recruiting goals by mental category and in terms of non-prior service (NPS) and prior service (PS) missions. Also, retention and initial entry training goals are established. This screen is where Firm Handshake permits team members to make strategic level manpower decisions. For example by setting retention goals at the strategic level broken down by first-termers, mid-termers, and careerists, we can set a policy to have a younger force that is cheaper but less experienced or vice versa. Figure 4.3 is a screen shot of Strategy Screen II.

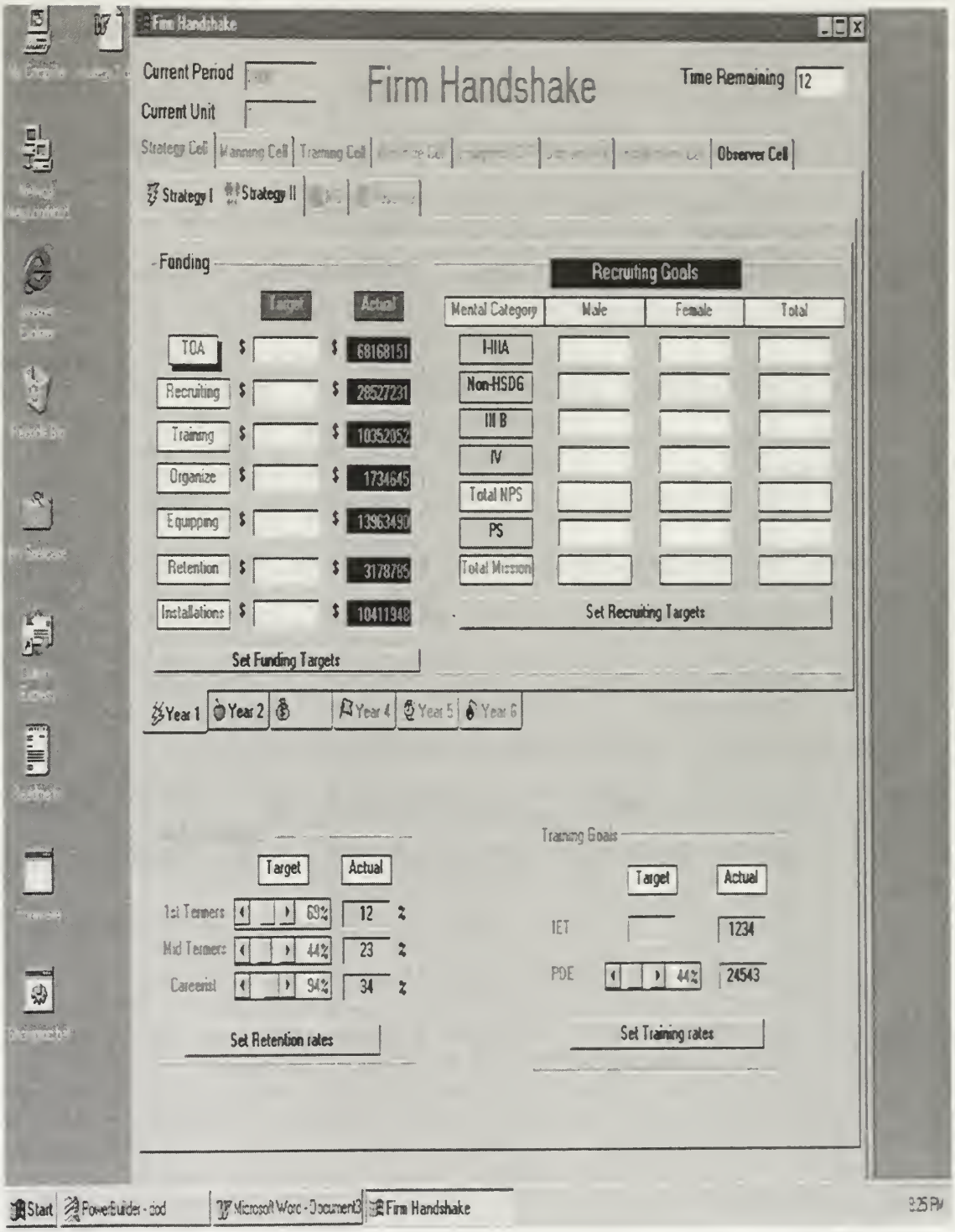

Figure 4.3 -- Firm Handshake Strategy Screen II

On Strategy Screen II the players control the following:

- ***Funding by Functional Area:*** The player is able to enter projected funding levels by Total Obligated Allowance (TOA) and by functional area (recruiting, training, organize, equipping, retention, and installations).
- ***Recruiting Goals:*** Recruiting goals are entered broken down by gender and non-prior service (NPS) and prior service (PS) missions. NPS goals are further broken down by mental category (I-IIIA, Non-High School Diploma Grad (NHDG), IIIB, and IV).
- ***Retention Goals:*** Retention goals are set for first-termers, mid-termers, and careerists.
- ***Training Goals:*** Training goals are set in terms of the number of training seats by initial entry training (IET) and Professional Development Education (PDE).

b) Relationships to Other Screens

The strategy screen sets overall strategic level policy. The other teams and screens deal with the operational and tactical level manpower decisions that implement this strategy. Therefore, we need to understand

how the strategy screen relates to the other screens. Table 4-1 describes the relationships between the strategy screens and the recruiting, training, and retention screens.

SCREEN	INPUT (from)	OUTPUT (to)
RECRUITING	• Mission accomplished in previous year by Mental Category • Budget requests / expenditures	• Mission by Mental Category • Manning Budget
TRAINING	• IET actual # trained • PDE actual # trained • Request for more facilities • Request for more instructors	• IET reqd # facilities • IET reqd # instructors • IET training seat requirements • PDE reqd # facilities • PDE reqd # instructors • PDE training seat requirements • Budget
RETENTION	• Actual 1st Termers Rate • Actual Mid-termers Rate • Actual Careerist Rate	• Target 1st Termers Rate • Target Mid-termers Rate • Target Careerist Rate • Budget

Table 4-1 -- Relationship between Strategy Screens and Recruiting, Training, and Retention Screens

c) Agent Relationships

Above, we have presented the inputs the strategy team controls, what each strategy screen looks like, and the relationships between the strategy screens and the other screens. Since, Firm Handshake is an Agent Based Simulation it is important to understand some of the underlying agent

relationships. There are three basic agent relationships that the strategy screen impacts.

First, when a unit is allocated to a particular MTW or SSC, unit agents must be modified to show that they are in an engagement, which engagement they are in, and when they are mobilized. This data will set an operations tempo (OpTempo) level for that unit. The individual soldier agents within that unit inherit the unit's OpTempo information.

Second, the force must initially be populated with units and soldiers assigned to those units. Each unit must have a profile showing a cross section of soldiers having representative values for various demographic characteristics. These attributes include military occupational specialty (MOS), length of service, race, gender etc. Lastly, each unit must be given a readiness rating. This readiness rating would be based on current readiness levels in the Army. A mean and standard deviation would be determined and then units would be randomly assigned a readiness rating.

3. Manning

In the Proof of Principle, the Manning team is broken down into three separate teams by manpower functional area: recruiting, retention, and distribute/transition. As seen

in Figure 4.1 only the recruiting and retention screens were active for the proof of principle.

a) Recruiting

(1) Controls and Screens

The recruiting team has only one screen to play. This screen takes the strategic recruiting goals set by the strategy team on Strategy Screen II and attempts to institute operational level decisions to execute the mission. Figure 4.4 shows a screen shot of what the recruiting team will encounter while playing the game.

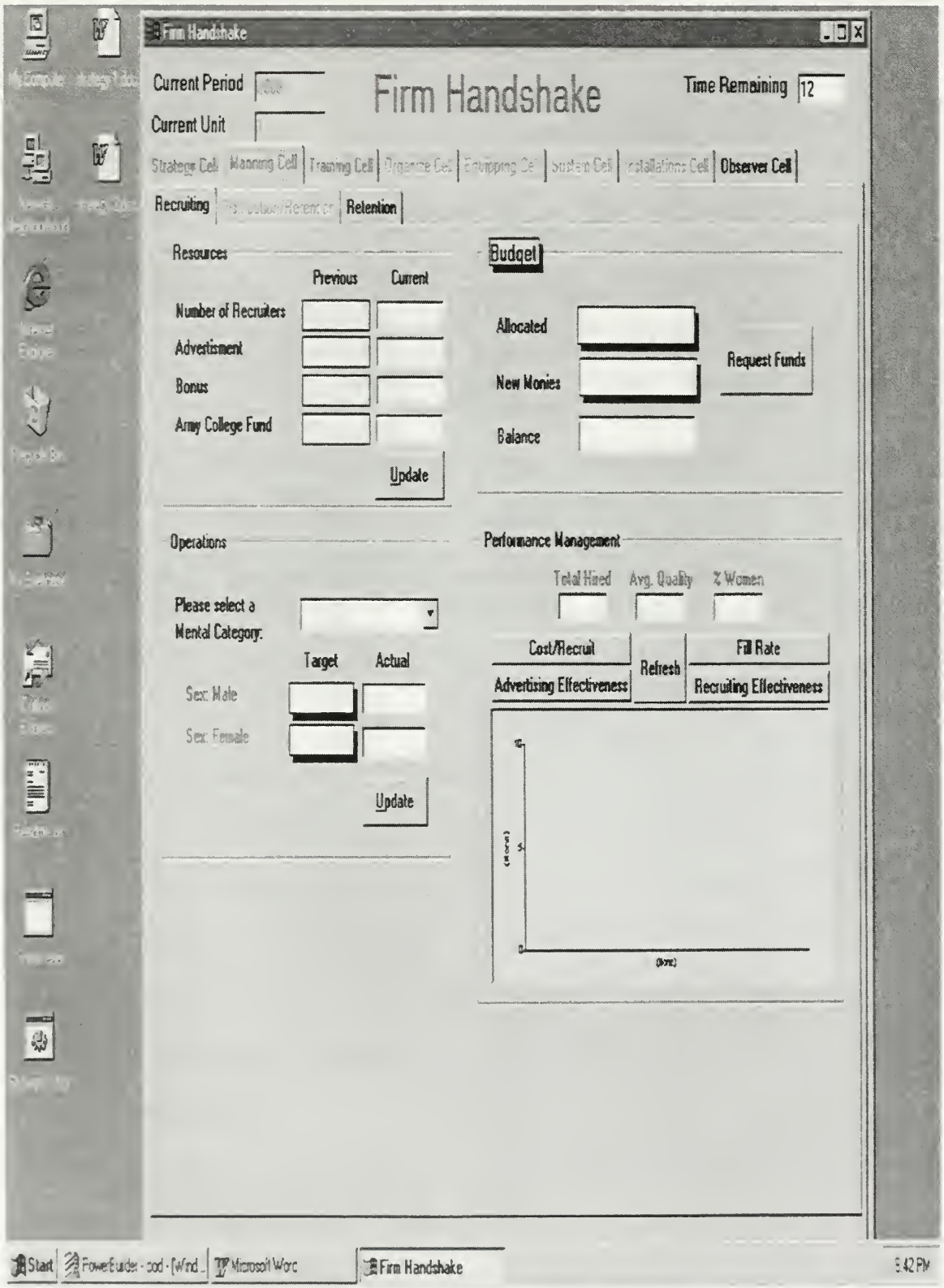

Figure 4.4 -- Firm Handshake Recruiting Screen

The recruiting team can control the following areas:

- ***Number of Recruiters:*** The team can set the number of recruiters. Then based on a productivity metric for each additional or each lost recruiter the actual numbers of recruits that enlist will be affected.
- ***Advertising Channels:*** The team can set the amount to spend in each of three advertising channels (television, radio, and print). The team can allocate resources based on the recruiting budget set by the strategy team. They can also request additional funds if they are not going to make their mission.
- ***Incentives (Enlistment Bonuses and Army College Fund (ACF)):*** The team can adjust the benefit or amount paid for enlistment bonuses and the overall benefit of the ACF.
- ***Mental Category Tradeoffs:*** The recruiting team can also request or recruit more of one mental category than was set by strategy team. This is done at the operational level in an attempt to limit shortfalls in overall mission accomplishment.

Overall, the recruiting screen is geared for the operational level of recruiting.

(2) Relationships to Other Screens

As with the strategy screen actions on the recruiting screen have effects on the other teams/screens in the game. Table 4-2 shows the relationships that exist between the recruiting screen and the strategy, training, and retention screens.

SCREEN	INPUT(from)	OUTPUT(to)
STRATEGY	• Mission by Mental Category • Manning Budget	• Mission accomplished in previous year • Budget requests / expenditures
TRAINING	• Training attrition rate and subsequent requirements for more recruiting	• # of recruits to train (by Mental Category)
RETENTION	• Realized Retention Rate determines Recruiting requirements for next year	None

Table 4-2 -- Relationship between Recruiting Screen and Strategy, Training, and Retention Screens

(3) Agent Relationships

If there is one area where Business wargaming and agent based simulation can truly provide some insight, it is in the recruiting field. Recruiting is closely tied to markets (economy, labor, industry, etc.), and thus the agents should be able to accurately capture aggregate market behavior as reflected in an individual's decision to enlist

or not. Table 4-3 shows a graphic representation of how we expect changes in the various parameters to affect the actions of the agents.

PARAMETER	Recruit's Decision to Enlist	Budget	Readiness
# Recruiters +-	+-	+-	+-
Advertisement $ +-	+-	+-	+-
Incentive $ +-	+-	+-	+-

Table 4-3 -- Recruiting Screen Agent Relationships

Although Table 4-3 gives us an understanding of the direction of the various agent relationships, it does not give us any insight into the magnitude and is therefore inadequate to accurately model behavior. Ideally we would have empirical relationships (e.g. regressions), or lacking that we would construct an associated utility graph determined by subject matter experts.

b) Retention

(1) Controls and Screens

Another area that is market-driven is retention. Unlike recruiting, many of the areas that can be captured in a simulation environment cannot be affected by planners but are determined by the President and Congress. Items such as base pay, bonuses, etc. have to be enacted by

law. Planners still follow the effects of these items on retention and make recommendations accordingly. To better understand what the retention team will encounter Figure 4.5 shows a screen shot of what the recruiting team will encounter while playing the game.

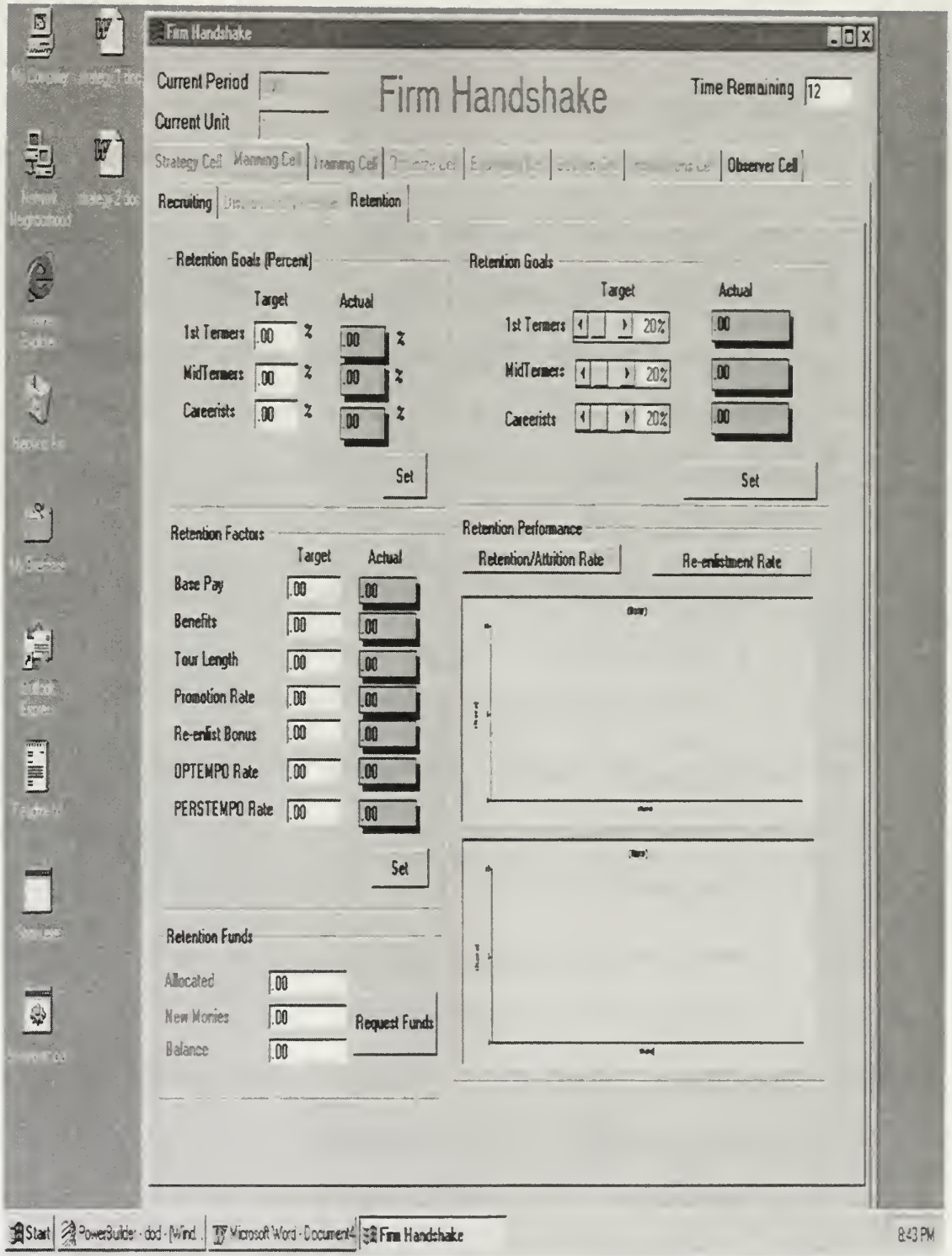

Figure 4.5 -- Firm Handshake Retention Screen

To that end the retention team can control the following inputs:

- ***Base Pay:*** The retention team can enter a figure for the average base pay for each soldier.
- ***Benefits:*** The team can also enter an average amount of benefits for each soldier. Benefits include such items as medical care, housing, and retirement.
- ***Tour Length:*** This is a number from 1 to 4 with four being perceived as a favorable tour length and one being perceived negatively.
- ***Promotion Rate:*** Like tour length, promotion rate is on a scale from 1 to 4 with the same positive and negative relationship.
- ***Reenlistment Bonus:*** This input is the average figure for the amount a soldier will receive upon reenlistment.
- ***OpTempo Rate:*** Input on a 1 to 4 scale with four being positive and one negative.
- ***PersTempo Rate:*** Input on a 1 to 4 scale with four being positive and one negative.

Also, the retention team can request additional funds from the strategy team to pay for the changes in the retention factors.

(2) Relationships to Other Screens

In the Proof of Principle the Retention screen has comparatively little interaction with the other teams/screens. Table 4-4 lists the relationships between the retention screen and the strategy, recruiting, and training screens.

SCREEN	INPUT(from)	OUTPUT(to)
STRATEGY	• Target 1st Termers Rate • Target Mid-termers Rate • Target Careerist Rate	• Actual 1st Termers Rate • Actual Mid-termers Rate • Actual Careerist Rate
RECRUITING	None	• Realized Retention Rate determines Recruiting requirements for next year
TRAINING	• Training attrition rate for PDE	• Training requirements for those troops retained

Table 4-4 -- Relationship between Retention Screen and Strategy, Recruiting, and Training Screens

(3) Agent Relationships

As in recruiting, an individual soldier's decision to stay or leave the military is very market driven. It also has a strong individual preference component. Individual preference is captured in OpTempo, PersTempo, and Tour Length. Table 4-5 shows the various agent relationships captured in the retention screen.

PARAMETER		Retention: Soldier's Decision to Stay	Budget	Readiness
Base Pay	+-	+-	+-	+-
Benefits	+-	+-	+-	+-
Tour Length	+-	??	-+	??
Promotion Rate	+-	+-	+-	+-
Reenl. Bonus	+-	+-	+-	+-
PersTempo	+-	-+	-+	-+

Table 4-5 -- Retention Screen Agent Relationships

As with recruiting, representing the mere direction of the relationship is not adequate to model behavior. Once again, empirical relationships or utility graphs are necessary to accurately model an individual soldier's retention behavior.

4. Training

a) Controls and Screens

Training is an important aspect of the manpower system. All new recruits must be trained but training involves not only initial entry training (IET) but also military occupational specialty (MOS) and professional development (PDE) training. For Firm Handshake only IET was enabled. Figure 4.6 is a screen shot of the training screen.

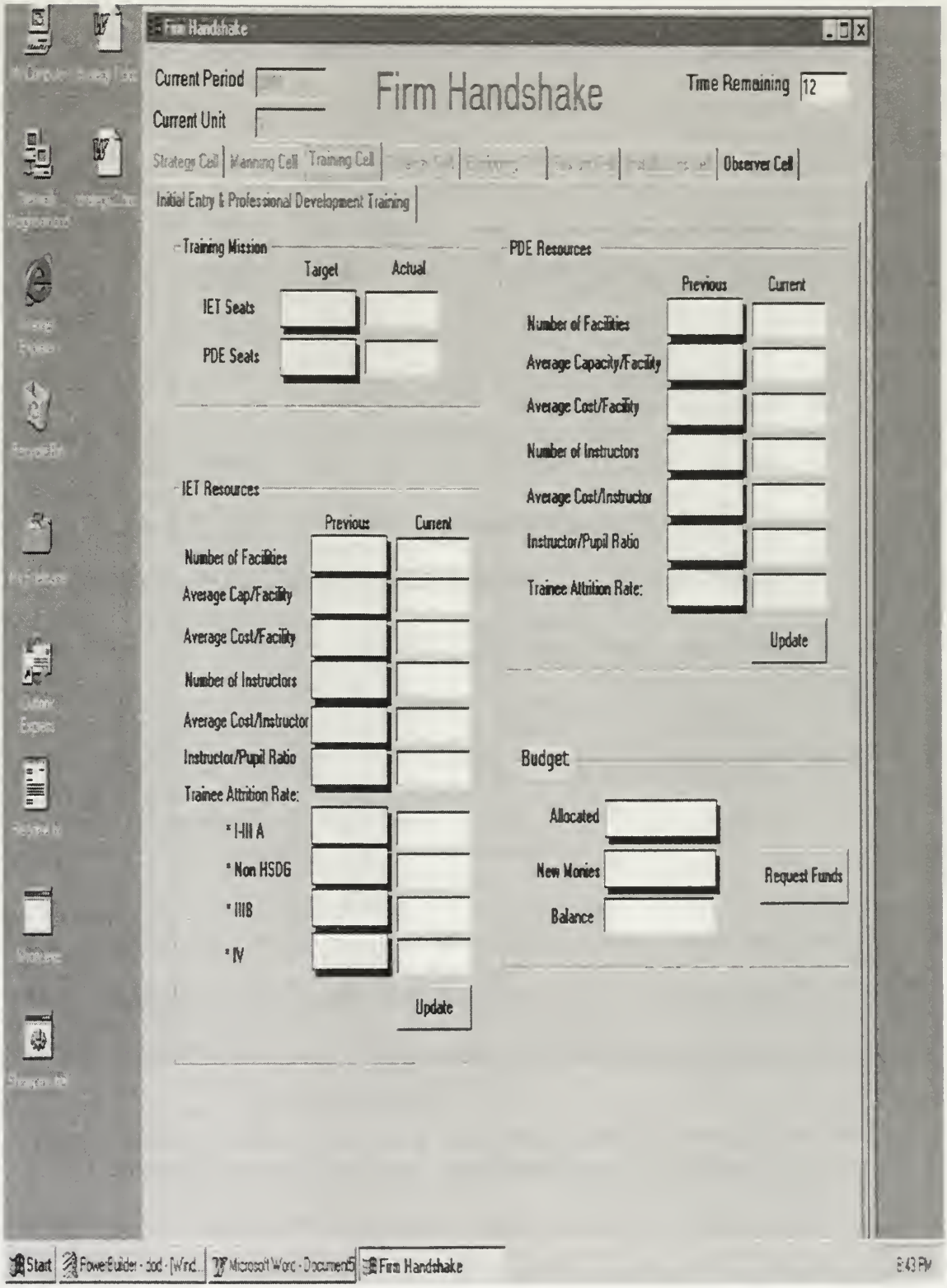

Figure 4.6 -- Firm Handshake Training Screen

The training team can control the following aspects:

- ***Number of Training Facilities:*** This is the total number of training facilities available to conduct IET.
- ***Average Capacity per Facility:*** This is the average throughput per facility. For example we can train an average of 2000 soldiers per facility per year.
- ***Average Cost per Facility:*** This is the average annual dollar amount to run each training facility.
- ***Number of Instructors:*** This is the total number of instructors at all training facilities.
- ***Average Cost per Instructor:*** This is the average annual cost of each instructor.
- ***Instructor/Pupil Ratio:*** This is the desired instructor to pupil ratio on average for each facility.
- ***Trainee Attrition Rate:*** This is the average attrition rate for each facility broken down my trainee mental category (I-IIIA, Non-HSDG, IIIB, and IV).

Additionally, on the screen presented as Figure 4.6, you will see many of this same inputs for PDE. As mentioned above this portion of the training screen was not enabled

for the Proof of Principle Exercise. As with recruiting and retention, the training team can also request new monies from the strategy team.

b) Relationships to Other Screens

Like the other teams, the actions by the training team have an effect on the missions/actions of the other teams. Table 4-6 shows the relationships between the training screen and the strategy, recruiting, and retention screens.

SCREEN	INPUT(from)	OUTPUT(to)
STRATEGY	• IET reqd # facilities • IET reqd # instructors • IET training seat requirements • PDE reqd # facilities • PDE reqd # instructors • PDE training seat requirements • Budget	• IET actual # trained • PDE actual # trained • Request for more facilities • Request for more instructors
RECRUITING	• # of recruits to train (by Mental Category)	• Training attrition rate and subsequent requirements for more recruiting
RETENTION	• Training requirements for those troops retained	• Training attrition rate for PDE

Table 4-6 -- Relationship between Training Screen and Strategy, Recruiting, and Retention Screens

c) Agent Relationships

Agent behavior in the case of the training team is much less market driven than driven by the decisions and actions of the training team itself. Table 4-7 shows the relationships that exist between the agents and the inputs the players can control and shows their expected effects.

PARAMETER	Budget	Readiness
Facilities +-	+-	+-
# Instructors +-	+-	+-
Amount of Distance Learning +-	+-	+-

Table 4-7 -- Training Screen Agent Relationships

As with recruiting and retention, representing the mere direction of the relationship is not adequate to model behavior. Once again, empirical relationships or utility graphs are necessary to accurately model an individual soldier's retention behavior.

5. Team Integration

There are several additional features included in the Proof of Principle that serve to increase player awareness and integration. Two such features are an observer cell

screen and an electronic mail (e-mail) feature. The observer screen displays several graphs such as readiness, overall cost, retention rate, recruiting by mental category, training costs, etc. This screen is updated at the end of each turn and each team can click on it to see not only where they stand but also how each of the other teams are completing their missions. The second key feature to help with team integration is a built in e-mail feature that allows each team to communicate with and make requests of one or more of the other teams. These two features enhance the connectivity and integration in Firm Handshake.

G. LESSONS LEARNED FROM FIRM HANDSHAKE

The Proof of Principle exercise of Firm Handshake generated many lessons learned. These lessons can be captured in five different areas, as covered individually below.

1. Requirements Generation/Development/Exercise Conduct

Whenever you develop something that is new, hindsight is often 20/20. Looking back at the path followed to get from a concept to the actual execution of the Proof of Principle can bear much fruit in developing similar products in the future. The first and most important step is determining the objective to be achieved by the simulation

exercise itself. Initially, Firm Handshake was seen as a possible tool for use in the next Quadrennial Defense Review (QDR). It was also "sold" as a possible manpower policy decision tool. Without a clear objective in mind, development is more of a guessing game than methodology-driven.

Once a clear set of objectives is determined, it is important to identify the type of scenarios that need to be tested. In a full production version, we expect any number of scenarios can be tested, but in a proof of principle version, at most three scenarios should be chosen. This will allow developers to concentrate their efforts and deliver a better product as the proof of principle.

The underlying data and metrics must be sound and realistic. They must be provided by the duty experts or taken from existing reputable studies. One key shortfall with Firm Handshake was this lack of data and metrics. Several reasons contributed to this shortcoming, they are as follows:

1. Buy-in at the highest level. There was no champion for this project at the General Officer level; thus numerous requests for data went unanswered. This caused programmers to guess at what the underlying relationships should look like.

2. The data needs to be the best possible and, if unavailable, a thorough literature review of relevant studies needs to be conducted and that data needs to be used.

3. Developers and end-users must meet and conduct brainstorming sessions at least once a month prior to any proof of principle exercise. This allows the end-user to see the interface, look at the existing relationships, and suggest changes that might be necessary.

4. The development team needs at least two days to install and debug the simulation prior to actually conducting the exercise. In conducting Firm Handshake there was only one day available to do this and the exercise suffered because of instability with the simulation. Most of this instability could have been eliminated with one more day of perpetration time.

2. Successes

Even with the many issues listed above that hampered development and exercise conduct, Firm Handshake had many successes. Firm Handshake was able to clearly show the many links across functional areas at the aggregate level. This ability allowed users to assess the impact of national

military strategies on manpower requirements, assess the change in budget authority on recruiting and retention, and assess the impact on training from changes in recruiting and retention.

This ability to show the connectivity across functional areas highlights the value of this type of simulation as a training tool for policy makers at all levels. It can allow policy makers to conduct "what if" analysis by testing various scenarios and adjusting the various inputs. Also, by looking at specific policies and their resultant outcomes, policy makers can potentially determine returns on investment (ROI's) for many policies e.g. increasing bonuses, seeing the effect on retention and determining the ROI.

The simulation and software used to create Firm Handshake had many positive factors too. The SEAS environment is very user friendly and allows for the modeling of critical manpower relationships. Once developed, changes to the simulation are relatively quick. This environment lends itself to allowing the user to see any number of measures of effectiveness. These might include readiness measures, mission accomplishment measures, cost measures, etc. The nature of Agent Based Simulation allows for the capturing of second order effects. One

example of this is we decide to ease the burden on recruiting. This leads us to lower the standards and allow a greater percentage of the lower mental categories to be recruited. Planners feel this will allow the Army to make their recruiting goal. A second order impact might be that the training attrition rate increases because in general lower mental category recruits attrite at a higher rate when compared to the upper mental categories. Now we have to train more recruits, which puts a strain on the training establishment, and simultaneously we have to recruit more to fill the ranks because of higher attrition.

One significantly positive aspect of this simulation is that it can be potentially very cost effective. If we can test manpower policies before implementation, see the second order effects and determine the ROI, we may be able to generate cost savings by implementing the policies that will provide us the most benefit with the least cost.

3. Issues

Even with the positive benefits listed above, there are many issues that need to be solved before Firm Handshake can move forward. First, the underlying data and metrics need to be improved. Each functional area needs to provide the developers with the most current data and the metrics that they are using. Second, current measures of effectiveness

are displayed as point estimates, these displays need to show a confidence interval instead of a mere point estimate. Lastly, the lines between active, reserve, and National Guard forces need to be solidified.

4. Graphic Interface

Another major area for improvement is the Firm Handshake user interface. I will not cover improvements that should be made to each specific screen but cover overall improvements that would aid the user when playing the game.

The biggest shortfall in the user interface dealt with not being able to clearly identify all data entry fields with respect to dimensions and units. E.g. displaying TOA_____ $ Billion would enable the user to enter "56.7" vice "56700000000". Additionally, being able to right click on a field and see the data dictionary description of the field, including the dimension and units would be a big boon. Both of these improvements across all screens would significantly facilitate the input process.

Reasonable default values need to be established across all screens as well. This would give players an ability to see a snapshot of where the Army stands with current policies, e.g. having the current default values for recruiting or retention, or training goals. Having the

current figures from the Five-Year Defense Plan (FYDP) entered across the budget input fields on the Strategy II Screen would greatly speed up the input process, giving players more time to strategize and develop plans. It would also allow for more realistic new policies because users would be able to see the current situation more clearly and make either large or small adjustments to policies from there.

Lastly, to be a true policy analysis tool there needs to be some elementary decision support tools integrated into the simulation. These tools would show the predicted effects of changing various inputs prior to actually running the software agents. For example, the retention team might enter a 5 percent base pay increase. Based on the metric for base pay this would increase retention by X percent. So the retention team would hit a button to show the predicted change in retention based on changing this one parameter, holding all else constant. This outcome might not be the actual outcome once the software agents run because of some other unforeseen market effect or because of the actions of another team, but being able to see the possible effects would allow players to make better judgements when entering inputs into their screens.

5. Next Steps

Overall, the Firm Handshake Proof of Principle exercise was quite successful and generated considerable participant enthusiasm. The Firm Handshake platform can be easily adapted to meet the requirements of a counterpart Marine Corps' business wargame. SimMarineCorps can benefit greatly from the lessons that the Army has already learned in developing Firm Handshake. To conduct a successful proof of principle exercise of their own, the Marine Corps needs to take maximum advantage of the resources the Army has already spent in developing this form of business wargame. To be successful the Marine Corps will need to focus on data/metric identification, streamlining the user interface, and ensuring that there is a champion at the General Officer level for this form of simulation.

V. SIMMARINECORPS

SimMarineCorps is a business wargame that uses agent-based simulation to model some of the business processes within the Marine Corps Human Resource Development Process (HRDP) in order to evaluate various manpower policy decision tradeoffs. Here we will discuss the SimMarineCorps objectives and detail a structure to meet those objectives. Specifically, we recommend scenarios, propose agent attributes, identify teams, player screens and controls, the relationships between the teams/players, the agent relationships, and the necessary data/metric requirements. We summarize by recommending proposed measures to support a successful proof of principle exercise.

A. BACKGROUND/OVERVIEW

In the last chapter, the U.S. Army Firm Handshake business wargame was reviewed with the lessons learned from the proof of principle exercise. Many of the features and screens from Firm Handshake can be tailored and used in the Marine Corps business wargame SimMarineCorps. In the following sections we provide the necessary information, data (where available), and recommendations to support development of the Proof of Principle version of SimMarineCorps by August 2000.

B. OBJECTIVE

SimMarineCorps is a Proof of Principle business wargame focusing on how various components of the Marine Corps business processes function and interoperate under differing circumstances. SimMarineCorps is an agent-based simulation utilizing agents that represent not only individual Marines and units, but also the external markets that affect the Marine Corps (industry, government, labor, economy, and universities). The benefit of this proof of concept is to create "Aha" experiences that will increase participant insight and awareness in the following areas:

- Connectivity among the various Marine Corps functional areas within the Human Resource Development Process (HRDP) as described in Chapter III.
- The value of taking a systems approach towards policy and decision-making within the HRDP.

In addition to creating the "Aha" experience the proof of concept will show the utility in using SimMarineCorps as a training tool for those within the HRDP. We expect the full version of SimMarineCorps to allow planners within the HRDP to use it as a tool to conduct policy analysis.

C. STRUCTURE OF SIMMARINECORPS

The structure of SimMarineCorps has many similarities to the Firm Handshake Proof of Principle business wargame, in that it is designed to capture the connectivity between the functional areas of the HRDP. Unlike Firm Handshake, SimMarineCorps will not try to capture all eight enterprises of CDS but will focus on one, that being HRDP. The critical functions within the HRDP include manning, recruiting, and training. Additionally within the manning section, we will capture retention. The Marine Corps must have an overall strategy to integrate these functional areas effectively. This strategy will determine what capabilities are needed for the Marine Corps, what resources are available (budget, units, weapons, personnel, etc.) and how to allocate these resources. One other aspect of SimMarineCorps that is different from Firm Handshake is that SimMarineCorps will include both officers and enlisted whereas Firm Handshake only included enlisted personnel. Figure 5.1 shows the proposed structure of SimMarineCorps.

Figure 5.1 -- Proposed Structure of SimMarineCorps

D. RECOMMENDED SCENARIOS FOR SIMMARINECORPS

SimMarineCorps will use the same geopolitical environment as Firm Handshake (See Appendix H). During the Proof of Principle exercise three scenarios will be presented that vary by economic or budgetary conditions. This is unlike Firm Handshake scenarios, which varied by economic and military conditions. Each scenario will start in fiscal year (FY) 2001, proceed through FY 2006, and consist of three moves of two years each.

The first scenario will reflect the current economic and budgetary conditions as of January 2000. The second

scenario will maintain current economic conditions/forecasts but include significant pressure for returning tax revenue surpluses (in the form of tax cuts), which would increase budgetary pressure. The third situation would reverse this vignette and incorporate various changes, both positive and negative, in the U.S. economy, with the budgetary situation remaining relatively stable. Economic conditions that could be varied include inflation, growth, unemployment, etc. These scenarios are designed to test the effects of various contingencies on the Marine Corps' HRDP. Some of the questions the scenarios would provide insight into include:

1. How does a booming economy effect recruiting/retention?
2. How budgetary pressures affect end strength?
3. How the external influences (economy and budget) affect the integration of policy across the many functional areas of the HRDP?

These are just a few of the possible "Aha" experiences that we expect to generate during the Proof of Principle exercise.

E. PROPOSED AGENT ATTRIBUTES

In Chapter II we discussed agent-based simulation and mentioned that agents are coded/governed by rules/attributes. Within the framework of SimMarineCorps

there are three forms of agents: individual potential recruits, individual Marines, and units. Table 5-1 shows the proposed data dictionary for individual potential recruits.

Data Dictionary for Individual Potential Recruits				
Attribute	***Description***	***Data Type***	***Domain of Values***	***Comments***
Age	Age in Years	Integer	>= 17, <=27	None
Race	Individuals Primary Race	Text	White, Black, Hispanic, Other	These variables would have to be coded as dummy variables
Gender	Individuals Gender	Text	Male or Female	These variables would have to be coded as dummy variables
Education Level	Highest Level of Education Achieved	Integer	0-20	<12=Non-HSDG, 12= HSDG, >12 & <16 = Some College, 16= College Grad, >16 = Above College Grad
Mental Category	Mental Category determined by score on AFQT	Integer	>0, < 100	0-9 = Not Qualified 10-16 = CATV 17-30 = CATIV 31-49 = CATIIIB 50-64 = CATIIIA 65-89 = CATII 90-99 = CATI
Propensity to Enlist	Desire of an Individual to Enlist	Percentage	0-100%	None

Table 5-1 - Proposed Individual Potential Recruit Agent Data Dictionary

Table 5-2 shows proposed characteristics for individual Marine agents.

Data Dictionary for Individual Marine Agents				
Attribute	*Description*	*Data Type*	*Domain of Values*	*Comments*
Age	Age in Years	Integer	>= 17, <=27	None
Race	Individuals Primary Race	Text	White, Black, Hispanic, Other	These variables would have to be coded as dummy variables
Gender	Individuals Gender	Text	Male or Female	These variables would have to be coded as dummy variables
Education Level	Highest Level of Education Attained	Integer	0-20	<12=Non-HSDG, 12= HSDG, >12 & <16 = Some College, 16= College Grad, >16 = Above College Grad
Mental Category	Mental Category determined by score on AFQT	Integer	>0, < 100	0-9 = Not Qualified 10-16 = CATV 17-30 = CATIV 31-49 = CATIIIB 50-64 = CATIIIA 66-89 = CATII 90-99 = CATI
Primary MOS	Primary MOS of Marine	Number	0100-9999	Detailed MOS List can be found in Appendix G
Secondary MOS	Any MOS other than the Primary MOS	Number	0100-9999	Detailed MOS List can be found in Appendix G
Rank	Current Rank of Marine	Text	E-1 to E-9, WO1, CWO2 to CWO5, O-1 to O-10	E = Enlisted WO & CWO = Warrant Officer O = Officer
Years of Service (YOS)	Current Number of Years on Active Duty	Integer	0-30	Mandatory Retirement E-6 and Below 20 O-4 and Below 20 All others 30
Length of Obligation	Current Number of Years left in Military Obligation	Integer	0-6	Regular Officers do not have an EAS
Marital Status	Marital Status of Marine	Text	Married, Single, Divorced, and Widowed	Dummy Variable will have to be coded
OpTempo	Individual's Sensitivity to increased OpTempo	Distribution	N/A	Distribution is at Appendix D

Table 5-2 -- Proposed Individual Marine Agent Data Dictionary

The next type of agent is the unit agent. Table 5-3 shows the proposed data dictionary for unit agents.

Data Dictionary for Individual Potential Recruits				
Attribute	*Description*	*Data Type*	*Domain of Values*	*Comments*
UIC	Unit Identification Code	Text	XXX	Each Marine Unit has a three digit UIC
Type	Unit Type SE, CE, GCE, ACE, or CSSE	Text	SE, CE, GCE, ACE, CSSE	These variables will have to coded as dummy variables
Readiness Rating	Unit Readiness based on Percentage of T/O (P-Rating)	Percentage	0-100%	Initial Distribution is at Appendix D
T/O	Unit Authorized T/O	Text	See Comments	T/O's are broken down by Grade and MOS each unit will use the Recapitulation by MOS section of the T/O which provides aggregate numbers by Grade and MOS See Appendix D

Table 5-3 -- Proposed Unit Agent Data Dictionary

The demographic data for individual Marines is located in Appendix B. Unit organization and T/O's are provided in Appendix C.

F. PROPOSED SIMMARINECORPS TEAMS

1. Game Master

The Game Master in essence is not a team but a person. There is no separate game master screen, rather the Game Master will work from the policy and force structure screen, which will be discussed in detail later. The Game Master's primary responsibility is to ensure that the policy team and the other teams in the game are aware of the current scenario, to ensure that teams operate within the given time limit, and clarify any areas of game-play.

2. Policy & Force Structure

a) Controls and Screens

The Policy & Force Structure screen of SimMarineCorps will be very similar to the Strategy II screen of Firm Handshake. In this screen the Policy team will set force structure requirements, policies, goals, and targets for the remaining teams. The policy and force structure team will set resource levels in terms of T/O requirements, budgets, personnel figures, end strength, etc. In SimMarineCorps there will not be a screen similar to the Strategy I screen of Firm Handshake. For SimMarineCorps

adjusting Marine Corps total T/O will set requirements. Furthermore, OpTempo is not determined by engagements as in Firm Handshake but rather is set by the policy and force structure team. Figure 5.2 is the proposed format for the policy screen, where grayed out boxes represent read only fields and white boxes allow for user input described below.

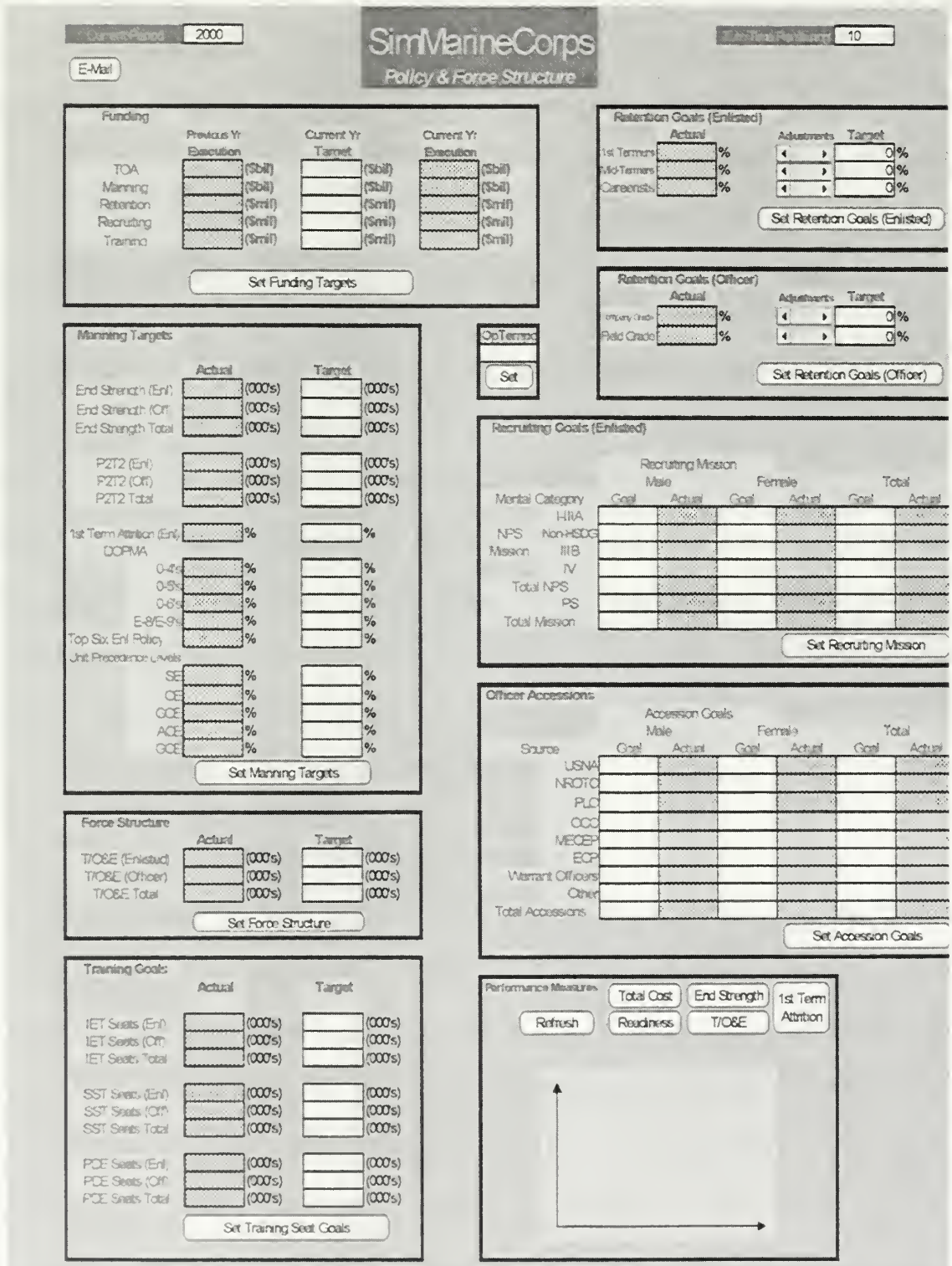

Figure 5.2 -- Proposed SimMarineCorps Policy & Force Structure Screen

The policy team can control the following aspects:

- *Funding:* The funding section is broken down by functional area (manning, retention, recruiting, and training). Within each section the Previous Year Execution box will be filled in from what was executed the previous year. The team then fills in the current budget for the fiscal year of the current game turn in the Current Year Target Box. Finally, the Current Year Execution will be displayed reflecting input/decisions from the other teams as the simulation proceeds.
- *Force Structure:* The force structure box allows the policy and force structure team to set the combat capabilities as outlined in chapter 3 during the CDS process in the form of Tables of Organization and Equipment (T/O&E's). The focus of SimMarineCorps will be on the organization in terms of numbers of officers and enlisted and not the equipment each unit requires. Actual T/O figures broken down by officer and enlisted are displayed in the "Actual" box. The policy and force structure team can then set a new target T/O figure based on the requirement to either add or eliminate a capability.

- *Manning Targets:* The policy team will set targets for the manning process. They will see current actual figures for end strength, P2T2, first term attrition, DOPMA and Marine Corps grade policies, and unit precedence levels. The policy team can then choose to set targets for any or all of these areas.
- *Retention Goals (Enlisted):* Retention goals for enlisted personnel are set in the form of a percentage for first termers (0-4 Years of Service (YOS)), mid-termers (4-8 YOS), and careerists (over 8 YOS).
- *Retention Goals (Officer):* Retention goals for officers are set in the form of a percentage for company grade officers (grades O-1 to O-3) and field grade officers (grades O-4 to O-6).
- *Recruiting Goals (Enlisted):* Recruiting goals for enlisted personnel are set by mental category for Non-prior service (NPS) enlistees, further divided by gender, and set by gender only for Prior Service (PS) enlistees.
- *Officer Accessions:* Officer Accession goals are set by accession source further divided by gender.

- *Training Goals:* Actual Training goals are displayed by training category (IET, SST, and PDE) sub-divided by enlisted and officer. The policy team can then set targets for the upcoming fiscal year for any or all of these categories.
- *OpTempo:* The policy team sets an OpTempo level. This will be a number between one and ten, with one being a relatively low OpTempo level and ten being an extremely high OpTempo level.

If the policy & force structure team decides not to adjust or set a particular target field it will default to the actual figure. With the many controls/inputs across many functional areas the policy & force structure team must include at least one duty expert from each functional area to ensure that the targets that are set within each category are realistic. The policy & force structure team sets the tone for the remaining teams in the game.

b) Relationships to Other Screens

The policy & force structure screen sets overall strategic level policy. The other teams and screens deal with the operational and tactical level manpower decisions that implement this strategy. Therefore, we need to understand how the strategy screen relates to the other screens. On the first turn of the game the fields labeled

"Actual" in all areas, funding, manning targets, force structure (T/O's), training goals, retention goals (enlisted and officer), and recruiting goals (enlisted and officer) will represent the current situation in the Marine Corps. On subsequent turns these actual fields will be filled in by the previous year's actual/target values from the respective teams screens. Table 5-4 describes the relationships between the Policy & Force Structure screen and the manning, retention, recruiting, and training (IET, SST, and PDE) screens.

SCREEN	INPUT (from)	OUTPUT (to)
MANNING	• Current Year Execution Budget • Target end strength by enl, off, and tot • Target first term attrition rate • Target Unit precedence levels • Target P2T2 by enl, off, and tot • Target DOPMA and USMC grade policies	• Next FY Previous Year Execution budget • Next FY actual end strength by enl, off, and tot • Next FY Actual 1st term attrition rate • Next FY actual unit precedence levels • Next FY actual P2T2 by enl, off, and tot • Next FY actual DOPMA and USMC grade policy
RETENTION	• Resource Requests (base pay, bonus, benefits)	• Next FY Funding (manning, retention)
RECRUITING	• Increased Resource request	• Next FY Recruiting Budget
TRAINING (IET, SST, and PDE)	• IET, SST, and PDE actual # trained • Request for more or less IET, SST, and PDE Resources (budget, facilities, instructors)	• Next FY actual trained by category • Next FY Previous Year Budget

Table 5-4 -- Proposed Relationship between Policy and Force Structure, Manning, Recruiting, Retention, and Training Screens

c) Agent Relationships

Above, we have presented the inputs the policy & force structure team controls, what the policy & force structure screen looks like, and the relationships between the policy screen and the other screens. Since, SimMarineCorps is an agent-based simulation it is important to understand some of the underlying agent relationships. There are two basic agent relationships that the policy & force structure screen impacts.

First, the force must initially be populated with units and Marines assigned to those units. Each unit must have a profile showing a cross section of Marines having representative values for various demographic characteristics. These attributes are listed in section E above. Each unit must also be given a readiness rating based on current readiness levels (SORTS' P-rating) in the Marine Corps. A mean and standard deviation can be determined with units then randomly assigned a readiness rating. The distribution of readiness ratings can be found in Appendix D.

Second, the OpTempo level set on the policy & force structure screen will have varying affects across all the other screens from retention, to recruiting, to manning, to training. The exact relationship will be discussed in the

sections below for each particular screen. Also, the utility curve for OpTempo is presented in Appendix B.

d) Data Requirements/Metrics

One potential drawback of an agent-based business wargame such as SimMarineCorps is the need for a large amount of supporting data. This was emphasized as an issue in the lessons learned section in Chapter IV. This data is necessary to set attributes and rules for the various agents, whether they represent individuals, units, commands, etc. It is important to note that we will not include the actual data necessary to develop SimMarineCorps in this chapter, but rather identify the data requirements necessary for its development. Where feasible, representative data will be presented in the form of an appendix. Table 5-5 represents the required data/metrics to develop the policy & force structure screen.

Data/Metrics Required to Develop the Policy & Force Structure Screen	
Data	
Type	***Location/Comments***
• Budget by functional area (manning, retention, recruiting, and training) for FY00-FY07.	• See Figure 3.3 and Table D-2 for FY00 budget figures, FY01-FY07 budget information requested from HQMC
• Marine Corps Unit Organization and Force Structure (T/O's)	• See Figures A.1 - A.4, C.1, C.2 and Tables C-1 - C-4, and Appendix C
• Current Snapshot of unit populations by grade and MOS	• See Appendix C
• Average cost of adding one officer and one enlisted to Force Structure	• Data unavailable, requested from HQMC
• End Strength Targets for FY00-FY07	• See Table D-1 for FY99-FY05 figures, FY06-FY07 requested from HQMC
• P2T2 level for FY00-FY07	• See Table 3-1 for FY99 P2T2 Figures, figures for FY01-FY07 requested from HQMC
• First-term Non-EAS Attrition Rate for FY00-FY07	• See Appendix D for FY00 First-term Non-EAS Attrition Rate, figures for FY01-FY07 requested from HQMC
• Retention goals for enlisted by first-term, mid-term, and careerists.	• See Appendix E for FY00 first-term retention goal, figures for all other levels requested from HQMC
• Enlisted Recruiting Goals by mental category (I-IIIA, IIIB, and IV) for FY00-FY07	• See Table F-1 for FY00-FY05 gross recruiting goals, mental category breakdown as well as figures for FY06-07 requested from MCRC, See Table F-2 for the FY99 quality spread.
• Officer retention goals for company and field grade	• Tables E-1 - E-7 show the officer management flow plan for FY99-FY04, figures for FY05-FY07 requested from HQMC
• Officer accession goals by source for FY00-FY07	• See Figure 3.8 for FY00 accession goals, figures for FY01-FY07 requested from MCRC, also Tables E-1 - E-7 show projected inflow of officers by commissioned and warrant officer but not by source for FY99-FY04
• DOPMA percentage levels by grade (O-4 to O-6 and E-8/9) for FY00-FY07	• See Table D-3 for DOPMA Years of Service (YOS) and promotion rate by grade, also, Tables E-1 - E-7 show officer flow from which these percentages can be extrapolated. See Appendix D for current E-8/9 DOPMA percentages
• Current USMC Top-Six enlisted policy	• See Appendix D
• Current Manning Precedence Levels by SE, CE, GCE, ACE, and CSSE	• See Figure 3.4
• Current Demographic snapshot of individual Marines	• See Tables B-1 - B-14
Metrics	
• Proposed Distribution of Unit Readiness	• See Figure C.3
• Relationship of OpTempo on retention and readiness	• Metric unavailable, information requested from HQMC
• Model for First-term Non-EAS attrition Rate	• See Appendix D
• Relationship between T/O&E and P2T2	• Metric unavailable, information requested from HQMC
• Relationship between T/O&E and end strength	• Metric unavailable, information requested from HQMC

Table 5-5 -- Data/Metrics Required to Develop the Policy & Force Structure Screen

Much of the above data exists but in the cases where it does not programmers/developers will need to meet with subject matter experts (SME's) to fill in the data/metric shortfalls.

3. Manning

a) Controls and Screens

The manning team has two screens to control, manning and retention. This is different from Firm Handshake, which also included recruiting within the manning team. Although intricately linked, recruiting is a separate command, as was described in Chapter III, and therefore will be considered as a separate team. This section will deal solely with the manning screen itself, retention will be covered as a separate section. Figure 5.3 is the proposed manning screen. As with the previous screen, read only cells are grayed out and user controlled cells are white.

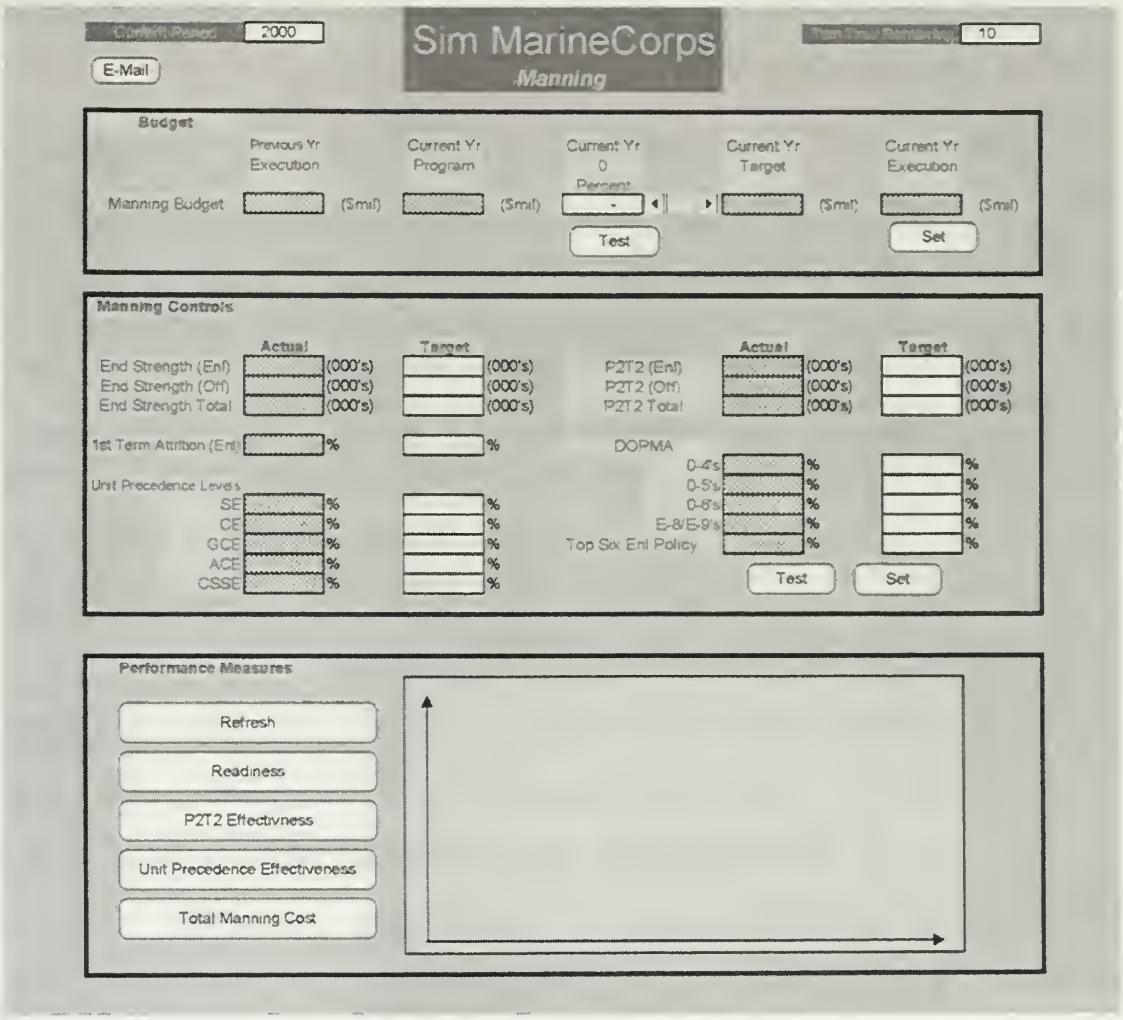

Figure 5.3 -- Proposed SimMarineCorps Manning Screen

The manning team can control the following:

- *Current Year Budget Adjustments: The* manning team can request adjustments to the current manning budget in the form of a percentage increase. This percentage is multiplied by the current year program budget and then added to it and placed in the current year target.

- *End Strength:* The manning team can set end strength levels by officer and enlisted.
- *First Term Non*-EAS Attrition: The percentage of enlisted first term non-EAS attrition is set in the form of a percentage of all first term enlistees.
- *Unit Precedence Levels:* The manning team can set the manning precedence levels by SE, CE, GCE, ACE, and CSSE.
- *P2T2:* Level of P2T2 by enlisted and officer is set in terms of total numbers.
- *DOPMA and USMC Grade Policy:* The manning team can adjust DOPMA constraints on field grade officers (O-4 to O-6) and top two enlisted grades (E-8 and E-9) as a percentage of total end strength. They can also adjust current USMC top-six enlisted policy in terms of a percentage of total enlisted end strength.

The manning team with these inputs will make adjustments in their budget first. Upon making these adjustment they can hit the "Test" button in the budget box. This "Test" button will act as a rudimentary decision support tool. Based on the data and metrics provided, it will give a projected figure in the "Target" fields within the manning controls box. The manning team can then either

make further budget adjustments, or if content with their budget level, they can press the "Set" button in the budget box. Once the "Set" button is hit, no further adjustments are possible. The manning team can also adjust the "Target" fields for all areas in the Manning Controls box. As with the "Test" button in the budget box, the manning team can see the potential outcome of their decisions in terms of impact on the budget. Once the respective manning controls have been set, the team presses the "Set" button in the Manning Controls box. Prior to pressing the "Set" button the manning team can press any of the performance measure buttons to see where they stand.

b) Relationships to Other Screens

Once policy & force structure (requirements/capabilities) are established, the manning process is key to all of the other manpower processes within the Marine Corps. The manning screen sets the tone in terms of end strength and unit manning levels. Table 5-6 shows the relationship between the manning screen and the policy, force structure, recruiting, retention, and training screens.

SCREEN	INPUT (from)	OUTPUT (to)
POLICY & FORCE STRUCTURE	• Previous Yr Execution and Current Yr funding for manning • Target end strength by enl, off, and tot • Target P2T2 level by enl, off, and tot • Target 1st term attrition rate • Target DOPMA and USMC grade policy percentages • Target unit precedence levels by SE, CE, GCE, ACE, and CSSE • Increase/Decrease in T/O&E	• Previous Yr Execution and Current Yr manning budget • Actual end strength by enl, off, and tot • Actual P2T2 level by enl, off, and tot • Actual 1st term attrition rate • Actual DOPMA and USMC grade policy percentages • Actual unit precedence levels by SE, CE, GCE, ACE, and CSSE • May or may not increase actual end strength
RETENTION	• Increase/Decrease in enl/off retention rate • Change in retention factors (base pay and benefits	• Increased/Decreased manning budget • Increased/Decreased manning budget
RECRUITING	• Actual enlisted and officer recruiting goals	• These figures affect the concert with retention and attrition effect actual end strength figures
TRAINING (IET, SST, and PDE)	• Target Training attrition for IET, SST, and PDE • Increased Instructors	• Actual 1st term non-EAS attrition • Increase in manning budget • Effect Actual unit precedence level

Table 5-6 -- Relationship Between Manning Screen and Policy & Force Structure, Recruting, Retention, and Training Screens

c) Agent Relationships

Agent behavior in the case of manning depends greatly on the policies and requirements set in the policy and force structure screens. Table 5-7 shows the

relationships that exist between the agents and the inputs the players can control and shows their expected effects.

PARAMETER	Budget	Retention	Recruiting Goals	Readiness
End Strength +-	+-	+-	+-	+-
1st Term Attrition +-	+-	+-	+-	-+
P2T2 +-	+-	+-	+-	-+
DOPMA/USMC Policy +-	+-	+-	-+	+-
Unit Precedence +-	+-	+-	+-	+-

Table 5-7 -- Manning Screen Agent Relationships

As with Firm Handshake, representing the mere direction of the relationship is not adequate to model behavior. Empirical relationships or utility graphs are necessary to accurately model an individual Marine's behavior.

d) Data Requirements

Some of the data/metrics listed here may be repetitive but it is necessary to see what data/metrics will drive each screen. Table 5-8 shows the required data/metrics to develop the manning screen.

Data/Metrics Required to Develop the Manning Screen	
Data	
Type	***Location/Comments***
• Manning Budget for FY00-FY07.	• See Figure 3.3 and Table D-2 for FY00 budget figures, FY01-FY07 budget information requested from HQMC
• Current cost of salary by rank and projected pay raises for FY00-FY07	• Current pay scale available online at [http://www.dfas.mil/money/milpay/pay/]
• End Strength Targets for FY00-FY07	• See Table D-1 for FY99-FY05 figures, FY06-FY07 requested from HQMC
• P2T2 level for FY00-FY07	• See Table 3-1 for FY99 P2T2 Figures, figures for FY01-FY07 requested from HQMC
• First-term Non-EAS Attrition Rate for FY00-FY07	• See Appendix D for FY00 First-term Non-EAS Attrition Rate, figures for FY01-FY07 requested from HQMC
• DOPMA percentage levels by grade (O-4 to O-6 and E-8/9) for FY00-FY07	• Tables E-1 - E-7 show officer gross numbers for FY99FY04 from these percentages can be extrapolated. See Appendix D for current E-8/9 DOPMA percentages
• Current USMC Top-Six enlisted policy	• See Appendix D
• Current Manning Precedence Levels by SE, CE, GCE, ACE, and CSSE	• See Figure 3.4
Metrics	
• Model for First-term Non-EAS attrition Rate	• See Appendix D
• Relationship between T/O&E and P2T2	• Metric unavailable, information requested from HQMC
• Relationship between T/O&E and end strength	• Metric unavailable, information requested from HQMC

Table 5-8 -- Data/Metrics Required to Develop the Manning Screen

4. Retention

a) Controls and Screens

Market forces drive individual retention behavior. Unlike recruiting, many of the areas that can be captured in a simulation environment cannot be affected by planners because they are determined by the President and Congress. Items such as base pay, bonuses, etc. have to be enacted by law, nevertheless planners can still track the effects of these items on retention and make recommendations accordingly. To better understand what the retention team

will encounter Figure 5.4 shows the proposed retention screen.

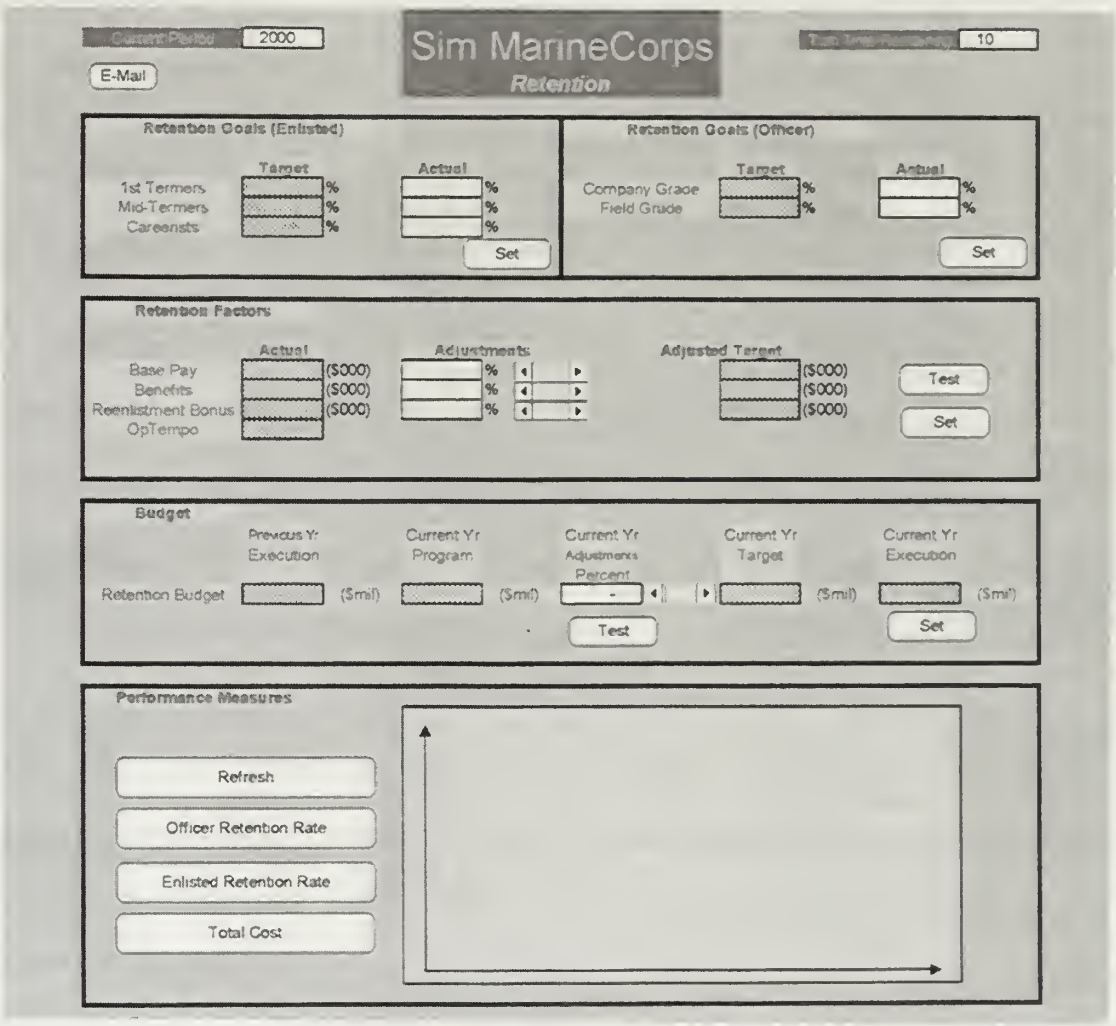

Figure 5.4 -- Proposed SimMarineCorps Retention Screen

The retention team can control the following:

- *Retention Goals (Enlisted):* The retention team can set target retention goals for enlisted Marines in three categories, first termers, mid-termers, and

careerists in the form of a percentage of the respective population.

- *Retention Goals (Officer):* The retention team can set target retention goals for officers in two categories, company grade and field grade, in the form of a percentage of the respective population.
- *Retention Factors: The* retention team can make percentage changes to the following factors that influence retention, base pay, benefits (retirement, medical, housing, etc.), and reenlistment bonuses.
- *Budget:* The retention team can make percentage changes to the Current Yr Program retention budget.

Like the manning and recruiting teams, the retention team has a limited form of decision support tool in two of its boxes: retention factors and budget. As the retention team makes adjustments to any of these two areas they can press the "Test" button which will put projected retention figures based on the underlying data/metrics in the respective Retention Goals "Actual" fields. As with the other screens, once they press "Set" no further changes can be made.

b) Relationships to Other Screens

Table 5-9 lists the relationships between the retention screen and the policy, force structure, manning, recruiting, and training screens.

SCREEN	INPUT(from)	OUTPUT(to)
POLICY & FORCE STRUCTURE	• Target Enlisted Retention Rates • Target Officer Retention Rates • Current Yr Target Funding for Retention • Increased/Decreased Force Structure can affect Retention requirements for next year	• Target Enlisted Retention Goals • Target Officer Retention Goals • Actual Careerist Rate • Current Yr Program Retention Budget • Realized Retention Rate determines Readiness
MANNING	• Realized 1st Term Non-EAS attrition determines Retention Requirements for next year	• Realized Retention Rate determines end strength figures for the next year
RECRUITING	• None	• Realized Retention Rate determines Recruiting requirements for next year
TRAINING (IET, SST, PDE)	• Training attrition rate for SST and PDE	• Training requirements for those troops retained

Table 5-9 -- Relationship between Retention Screen and Policy & Force Structure, Manning, Recruiting, and Training Screen

c) Agent Relationships

As in recruiting, an individual Marines' decision to stay or leave the military is very market driven. It also has a strong individual preference component. Individual preference is captured in OpTempo. Table 5-10 shows the

various agent relationships captured in the retention screen.

PARAMETER		Retention: Marines' Decision to Stay	Budget	Readiness
Base Pay	+-	+-	+-	+-
Benefits	+-	+-	+-	+-
Reenl. Bonus	+-	+-	+-	+-
OpTempo	+-	-+	-+	-+

Table 5-10 -- Retention Screen Agent Relationships

Representing the mere direction of the relationship is not adequate to model behavior. Once again, empirical relationships or utility graphs are necessary to accurately model an individual Marine's retention behavior. Ideally we would have empirical relationships (e.g. regressions), or lacking that we would construct an associated utility graph determined by subject matter experts.

d) Data Requirements

Table 5-11 shows the required data/metrics to develop the retention screen.

Data/Metrics Required to Develop the Retention Screen	
Data	
Type	***Location/Comments***
• Retention Budget for FY00-FY07.	• See Figure 3.3 and Table D-2 for FY00 budget figures, FY01-FY07 budget information requested from HQMC
• Current cost of salary by rank and projected pay raises for FY00-FY07	• Current pay scale available online at [http://www.dfas.mil/money/milpay/pay/]
• Current cost of benefits	• See Table D-2 and the Defense Finance and Accounting Service Website at [http://www.dfas.mil]
• Retention goals for enlisted by first-term, mid-term, and careerists.	• See Appendix D for FY00 first-term retention goal, figures for all other levels requested from HQMC
• Officer retention goals for company and field grade	• Tables E-1 - E-7 show the officer management flow plan for FY99-FY04, figures for FY05-FY07 requested from HQMC
Metrics	
• Retention Model	• Metric unavailable, information requested from HQMC.
• Relationship of OpTempo on retention and readiness	• Metric unavailable, information requested from HQMC
• Model for First-term Non-EAS attrition Rate	• See Appendix D
• Projected affect of reenlistment bonuses	• See Table E-2

Table 5-11 – Data/Metrics Required to Develop the Retention Screen

5. Recruiting

a) Controls and Screens

The recruiting team is a sub-team of manning and has one screen to play. This screen takes the strategic recruiting goals set by the policy team on the Policy Screen and attempts to institute operational level decisions to execute the mission. Figure 5.5 shows a proposed configuration of the recruiting team's screen.

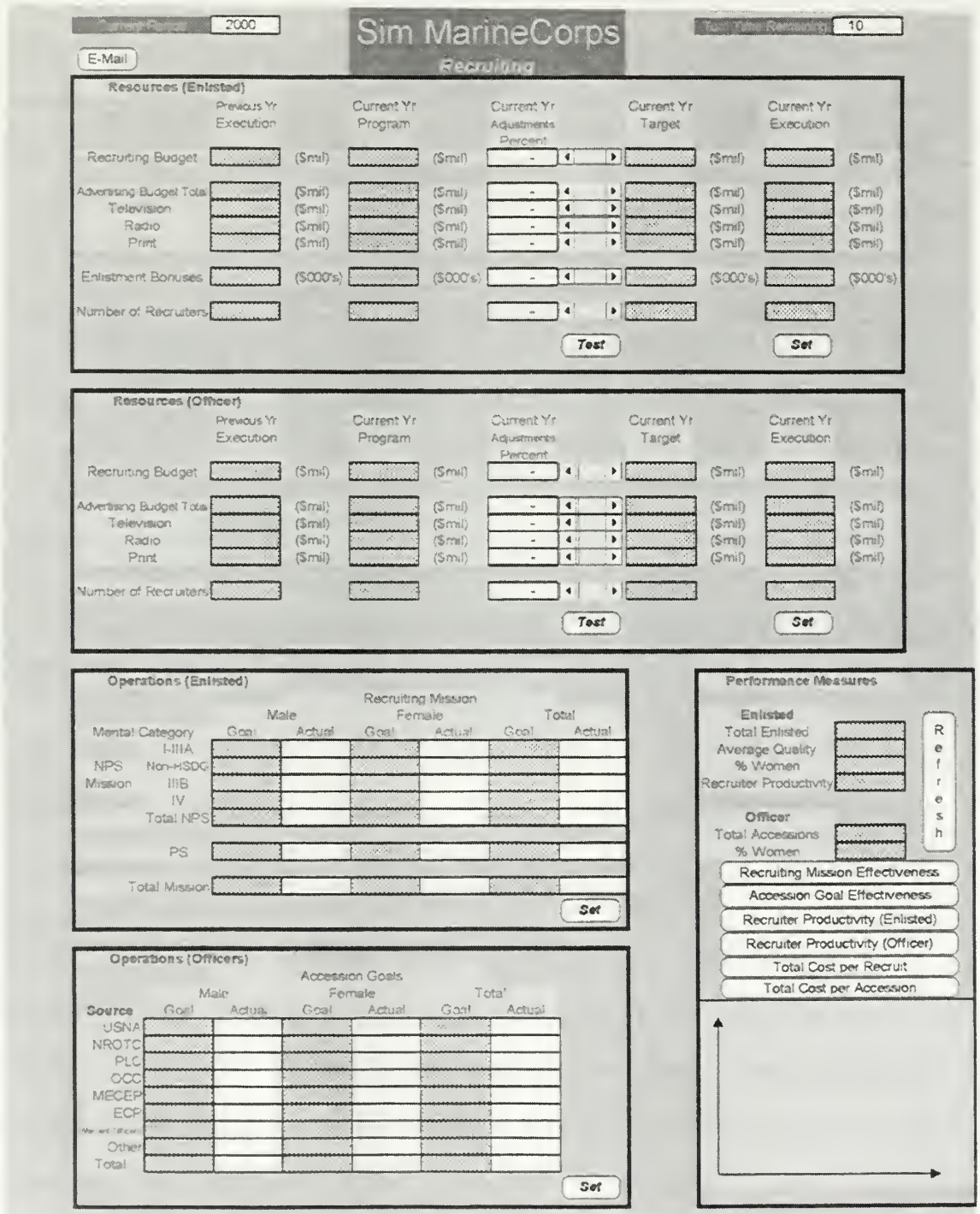

Figure 5.5 -- Proposed SimMarineCorps Recruiting Screen

The recruiting team can control the following:

- *Resources (Enlisted) Current Yr Adjustments: The* recruiting team can make percentage adjustments to any of the resources available to them (recruiting budget, advertising budget (television, radio, and print), enlistment bonuses, and number of recruiters). These adjustments are made to the Current Yr program figure and then calculated as the Current Yr Target field.
- *Resources (Officer) Current Yr Adjustments: The* recruiting team can make percentage adjustments to any of the resources available to them (recruiting budget, advertising budget (television, radio, and print), enlistment bonuses, and number of recruiters. These adjustments are made to the Current Yr program figure and then calculated as the Current Yr Target field.
- *Recruiting Mission (Actual):* The recruiting team can make recruiting mission changes to the goals the policy team has set by mental category and gender.
- *Accession Goals (Actual):* The recruiting team can make accession goal adjustment to the goals the policy team has set by accession source and gender.

The recruiting team with these inputs will make adjustments in their resources first. Upon making these adjustments they can press the "Test" button in either resource box. This "Test" button will act as a rudimentary decision support tool, based on the data and metrics provided, giving a projected figure in the recruiting mission and accession goal "Actual" fields. The recruiting team can then either make further resource adjustments, or if satisfied with their resource levels, can press the "Set" button in the respective resource box. Once the "Set" button is pressed no further adjustments are possible. The recruiting team can also adjust the enlisted or officer goals by adjusting the respective fields as described above. Once goals have been set, the team presses the respective "Set" button in the respective operations box. Prior to pressing the set button the recruiting team can hit any of the performance measure buttons to see where they stand.

b) Relationships to Other Screens

As with the policy & force structure, manning and retention screens actions on the recruiting screen have effects on the other teams/screens in the game. Table 5-12 shows the relationships that exist between the recruiting screen and the policy, force structure, manning, and training screens.

SCREEN	INPUT(from)	OUTPUT(to)
POLICY & FORCE STRUCTURE	• Enlisted Recruiting Mission Target by Mental Category and Gender • Officer Accessions Goal Target by Source and Gender • Current Yr Target Recruiting Budget • Increased/Decreased Force Structure can affect Recruiting requirements for next year	• Operation (Enlisted) Recruiting Mission Goal by Mental Category and Gender • Operations (Officer) Accessions Goals Goal by Source and Gender • Resources (Enlisted & Officer) Current Yr Program Recruiting Budget
MANNING	• Realized 1st Term Non-EAS attrition determines Recruiting Requirements for next year	• None
RETENTION	• Realized Retention Rate determines Recruiting requirements for next year	• None
TRAINING (IET, SST, PDE)	• Training attrition rate and subsequent requirements for more recruiting	• None

Table 5-12 -- Relationship between Recruiting Screen and Policy & Force Structure, Manning, Retention, and Training Screens

c) Agent Relationships

If there is one area where business wargaming and agent-based simulation can truly provide some insight, it is in the recruiting field. Recruiting is closely tied to markets (economy, labor, industry, etc.), and thus the agents should be able to accurately capture aggregate market behavior as reflected in an individual's decision to enlist or not. Table 5-13 shows a graphic representation of how we

expect changes in the various parameters to affect the actions of the agents.

PARAMETER	Recruit's Decision to Enlist	Budget	Readiness
# Recruiters +-	+-	+-	+-
Advertisement $ +-	+-	+-	+-
Incentive $ +-	+-	+-	+-

Table 5-13 -- Recruiting Screen Agent Relationships

Although Table 5-13 gives us an understanding of the direction of the various agent relationships, it does not give us any insight into the magnitude and is therefore inadequate to accurately model behavior. Ideally we would have empirical relationships (e.g. regressions), or lacking that, we would construct an associated utility graph determined by subject matter experts.

d) Data Requirements

Table 5-14 shows the data/metrics required to develop the recruiting screen.

Data/Metrics Required to Develop the Recruiting Screen	
Data	
Type	*Location/Comments*
• Recruiting Budget broken down by enlisted and officer for FY00-FY07.	• Data requested from MCRC
• Number and location of Recruiting Stations	• See Figure 3.5
• Average Enlisted Recruiter Productivity	• See Chapter 3, Footnote 34
• Average Officer Recruiter Productivity	• Data requested from MCRC
• Enlisted Recruiting Goals by mental category (I-IIIA, IIIB, and IV) for FY00-FY07	• See Table F-1 for FY00-FY05 gross recruiting goals, mental category breakdown as well as figures for FY06-07 requested from MCRC, In the absence of projected quality spread of new recruits, quality spread for FY99 is provided in Table F-2
• Officer accession goals by source for FY00-FY07	• See Figure 3.8 for FY00 accession goals, figures for FY01-FY07 requested from MCRC, also Tables E-1 - E-7 show projected inflow of officers by commissioned and warrant officer but not by source for FY99-FY04
• Average Cost per Recruiter, enlisted and officer	• Data requested from MCRC
• Average cost per contract, enlisted and officer	• Data requested from MCRC
• Propensity to Enlist by mental category	• See Figure F.1 for overall propensity to enlist figures
•	•
Metrics	
• Model of the affects of adding additional recruiters on actual number enlisted/accessed	• See Appendix F
• Model of the affects of adding advertising dollars on actual number of enlisted/accessed	• See Appendix F
• Model of the affects of other services recruiting efforts	• See Appendix F
• Model of the affect of enlistment bonuses/college fund on propensity to enlist	• See Appendix F

Table 5-14 -- Data/Metrics Required to Develop the Recruiting Screen

6. Training

a) Controls and Screens

Training is an important aspect of the manpower system. All new recruits must be trained, however training involves not only Initial Entry Training (IET) but also specialized Skill Training (SST) and Professional

Development Education (PDE). Each type of training has its own screen but they are essentially the same as far as inputs are concerned. Therefore this section will show all three screens but only supply the description for one since that description applies to all three. We envision only one training team with a duty expert from each type of training to control the respective screens. Figures 5.6, 5.7, and 5.8 are the IET, SST, and PDE training screens respectively.

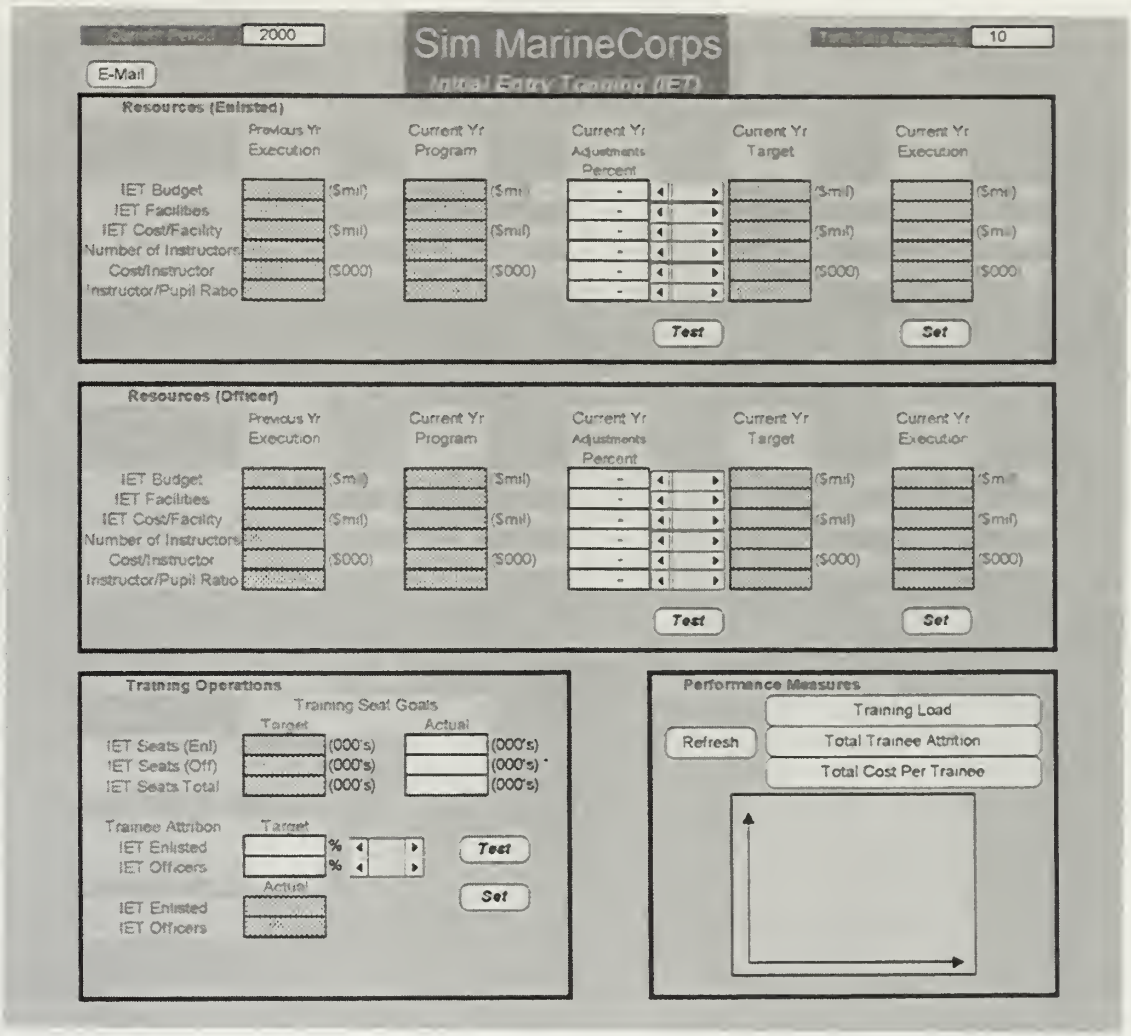

Figure 5.6 -- Proposed SimMarineCorps IET Training Screen

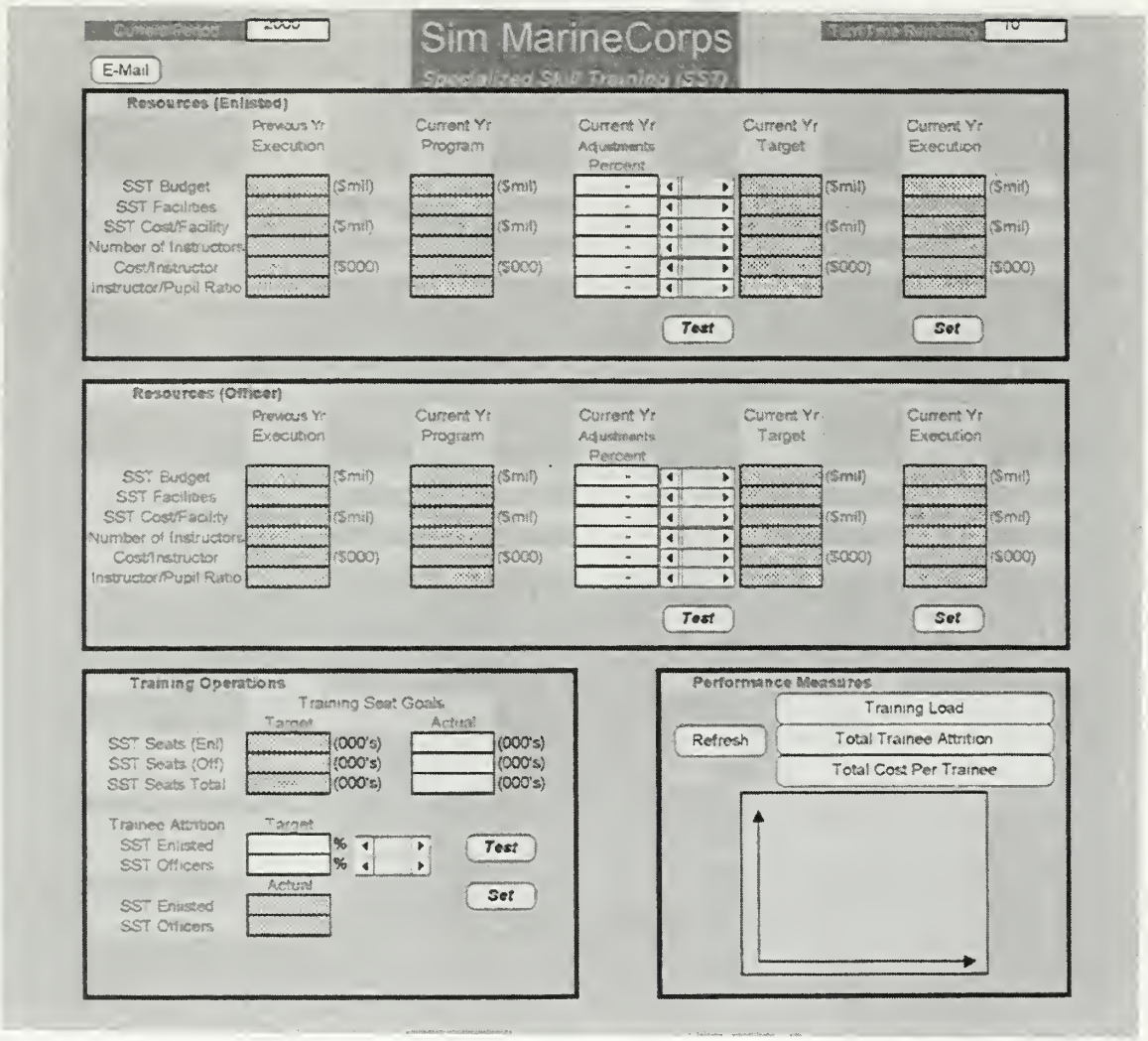

Figure 5.7 -- Proposed SimMarineCorps SST Training Screen

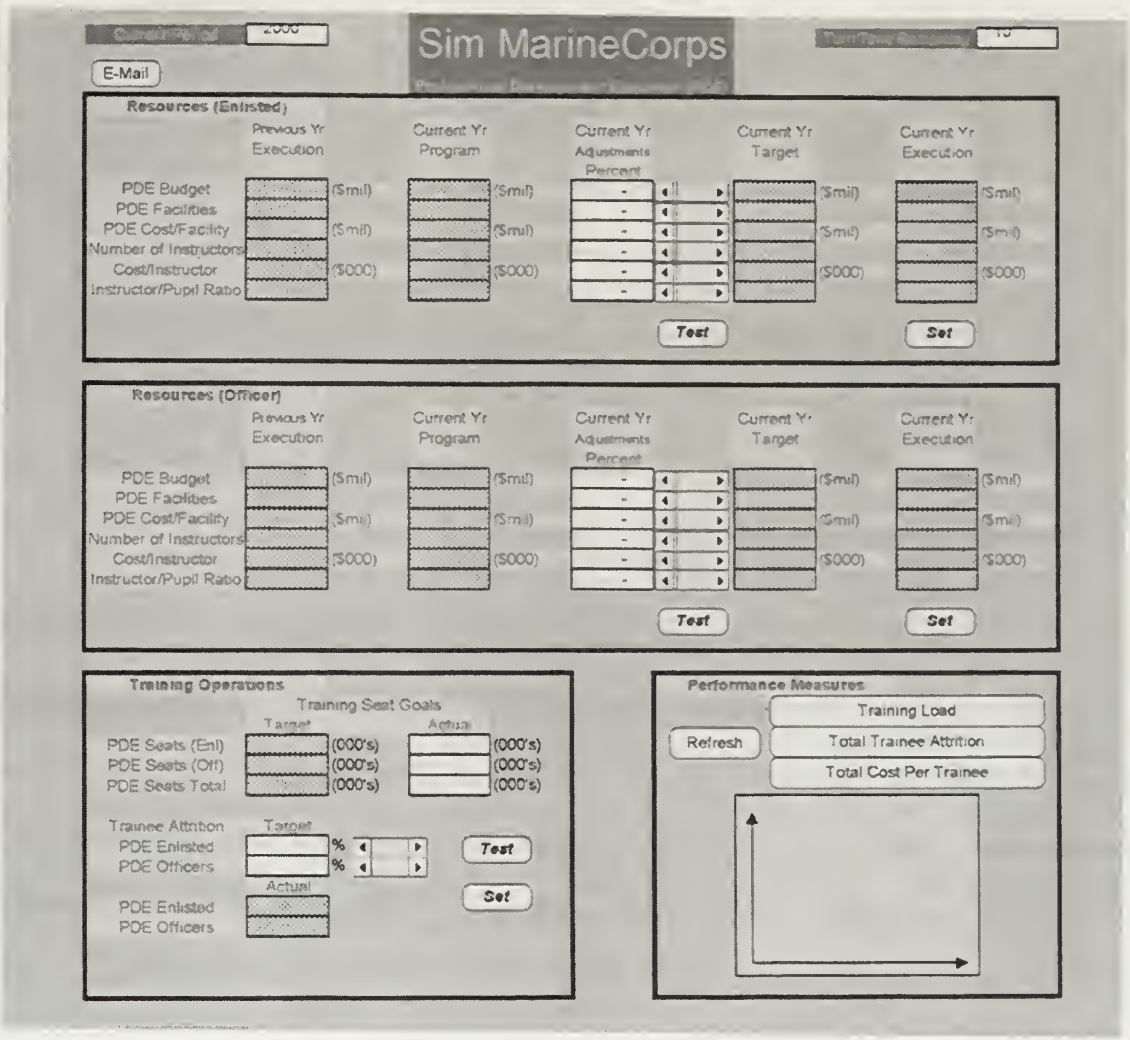

Figure 5.8 -- Proposed SimMarineCorps PDE Training Screen

The training teams (IET, SST, and PDE) control the following on each respective screen:

- *Resources (Enlisted):* Each of the training screens allows the training team to make percentage changes to the following, budget, facilities, cost per facility, number of instructors, cost per instructor, and instructor to pupil ratio.

- *Resources (Officer):* Each of the training screens allows the training team to make percentage changes to the following, budget, facilities, cost per facility, number of instructors, cost per instructor, and instructor to pupil ratio.
- *Training Operations:* Each of the training screens allows the training team to set "Actual" training seat goals and "Target trainee attrition rate for both enlisted and officers.

b) Relationships to Other Screens

Like the other teams, the actions by the training team have an effect on the missions/actions of the other teams. Table 5-15 shows the relationships between the training screens (IET, SST, and PDE) and the policy & force structure, manning, recruiting, and retention screens.

SCREEN	INPUT(from)	OUTPUT(to)
POLICY & FORCE STRUCTURE	• Target Training Goals by enlisted officer and total for IET, SST and PDE • Training Funding • Increased/Decreased Force Structure can effect Training Seat requirements for next year	• Target Training Goals by enlisted, officer, and total for IET, SST, and PDE • Current Yr Program Training Budget • Trained/Untrained Marines will have a direct effect on Readiness
MANNING	• Increase/Decrease in DOPMA or Grade Policy will effect requirements for SST and PDE • Increase/Decrease in end strength will effect requirements for training seats for next year	• Increased Trainee Attrition for IET and SST will effect 1st Term non-EAS Attrition • Increased/Decreased Training Load will increase/decrease P2T2 respectively
RETENTION	• Training requirements for those troops retained	• Training attrition rate for PDE
RECRUITING	• # of recruits to train (by Mental Category)	• Training attrition rate and subsequent requirements for more recruiting

Table 5-15 -- Relationship Between Training (IET, SST, and PDE) Screens and Policy, Force Structure, Manning, Recruiting, and Retention Screens

c) Agent Relationships

Agent behavior in the case of the training team is much less market driven than driven by the decisions and actions of the training team itself. Table 5-16 shows the relationships that exist between the agents and the inputs the players can control and shows their expected effects.

PARAMETER	Budget	Readiness
Facilities +-	+-	+-
# Instructors +-	+-	+-
Trainee Attrition +-	+-	-+

Table 5-16 -- Training Screen (IET, SST, and PDE) Agent Relationships

As with recruiting and retention, representing the mere direction of the relationship is not adequate to model behavior.

d) Data Requirements

Table 5-17 shows the data/metrics required to develop the three training screens (IET, SST, and PDE).

Data/Metrics Required to Develop the Training Screens	
Data	
Type	***Location/Comments***
• Training Budget broken down for IET, SST, and PDE by enlisted and officer for FY00-FY07.	• See Tables G-1 and G-2 for FY00 training budget information, data for FY01-FY07 requested from T&E Division
• Current number of facilities, facility capacity, cost per facility and number of trainees broken down by enlisted and officer for IET, SST, and PDE.	• See Tables G-1, G-2, G-4, and G-5
• Current number of instructors and average cost per instructors by enlisted and officer for IET, SST, and PDE.	• See Tables G-2, G-4, and G-5
• Average instructor to pupil ratio by enlisted and officer for IET, SST and PDE.	• See Table G-5
• Training time for enlisted and officer for IET, SST, and PDE	• See Table G-3
• Current trainee attrition rate by enlisted and officer for IET, SST, and PDE.	• Data Requested from T&E division, also data can be derived from Table H-5 that shows inputs and graduates for each course. Attrition rate can be calculated from by the following equation, (Inputs + Graduates)/Inputs.
• Annual training seat requirements by enlisted and officer for IET, SST, and PDE.	• See Table G-5
Metrics	
• Relationship between instructor to pupil ratio and trainee attrition	• Data requested from T&E Division, also relevant literature reviewed, unable to determine relationship
• Relationship between trainees attrition and readiness	• Data requested from T&E Division, also relevant literature reviewed, unable to determine relationship

Table 5-17 -- Data/Metrics Required to Develop the Training Screens

7. Team Integration

Like Firm Handshake, SimMarineCorps should have features that serve to increase player awareness and integration. One feature that will allow this is the same type of electronic mail (e-mail) system included in Firm Handshake. This feature will increase communication and connectivity between the various teams. Another feature is the performance measure portion of each screen. These performance measures provide a snapshot of current

performance and allow teams to integrate and make better decisions. Finally, the imbedded rudimentary decision support tools should limit policies/decisions that are detrimental to performance in the game. These features enhance the connectivity and integration in SimMarineCorps. This chapter recommended one possible structure for a business wargame that models the Marine Corps' Human Resource Development Process. It is clear that like Firm Handshake, data and metric collection and identification are the most significant hurdles to overcome in developing such a simulation.

G. PROOF OF PRINCIPLE EXERCISE RECOMMENDATIONS

Now that we have suggested a structure for SimMarineCorps, we must look at the path necessary to make such a business wargame become reality. Currently the target date for a Proof of Principle exercise for a Marine Corps business wargame is August 2000. To insure success the following areas must be addressed:

- Data/Metrics: The data and metrics presented in the body of this text and appendices must be validated by the appropriate command (M&RA, MCRC, T&E, TFS, etc.), further research (by Officer of Naval Research ONR or other similar organization and other NPS thesis students). In cases where data is not

available or no metric exists, at least two months prior to a proof of principle exercise, subject matter experts must meet with developers to work out these details. Tables 5-5,8,11,14, and 17 summarize the required data/metrics, location within this thesis (if available), and current status to develop all of the screens for SimMarineCorps.

- Brainstorming Session: One month prior to a proof of principle, developers and representatives from each team must meet to go over every detail including screen design, input fields, and performance measures.
- Proof of Principle Facility: An appropriate facility with a Windows NT™ server and one dedicated computer for each team is necessary. Each of the computers must be networked together. Also, appropriate briefing and workspaces for each team are required.
- Proof of Principle Schedule: The proof of principle exercise will need a total of four days. Two days for set-up (teams not required to attend but the facility will have to be dedicated for this time period). There will then be two days for game play; this will include a half-day for in-brief/training,

one full day of game play, and another half day for hot wash-up/debrief.

With these steps and the proposed structure of SimMarineCorps presented above, an agent-based simulation of the Marine Corps HRDP is possible. Tables 5-18 to 21 summarize the teams, agents, development schedule and exercise schedule for SimMarineCorps.

SimMarineCorps Team Summary		
Proposed Teams	***Recommended Team Composition***	***Description Location***
Game Master	Recommend an appropriate Manpower Section Head act as Game Master	Chapter 5, Section F.1.
Policy & Force Structure	Recommend one person form each of the following organizations: M&RA (one rep from MP division and one each from MMOA and MMEA), MCRC, T&E Division, TFS	Chapter 5, Section F.2.
Manning w/Retention	Recommend representation from MP, MMOA, and MMEA division of M&RA	Chapter 5, Sections F.3&4.
Recruiting	Recommend at least two representative from MCRC one for officer accession and the other for enlisted recruiting	Chapter 5, Section F.5.
Training (IET, SST, and PDE)	Recommend three personnel from T&E Division, one for IET, SST, and PDE	Chapter 5, Section F.5.

Table 5-18 -- SimMarineCorps Team Summary

SimMarineCorps Agents Summary	
Type	***Data Dictionary Location***
Individual Potential Recruits	Table 5-1
Individual Marines	Table 5-2
Units	Table 5-3

Table 5-19 -- SimMarineCorps Agents Summary

SimMarineCorps Proof of Principle Development Schedule	
Event	*Target Completion Date*
Requirements Document	March 2000
Data Collection/Validation	June 2000
Brainstorming Session	July 2000
Conduct Proof of Principle	August 2000

Table 5-20 -- SimMarineCorps Proof of Principle Development Schedule

SimMarineCorps Proof of Principle Exercise Schedule		
Event	*Participants*	*Day*
Set-up	Development Team	Day 1 and 2
In-brief	All Teams	Day 3 a.m.
Simulation Training	All Teams	Day 3 a.m.
Scenario one	All Teams	Day 3 p.m.
Scenario Two	All Teams	Day 4 a.m.
Scenario Three	All Teams	Day 4 p.m.
Hot wash-up	All Teams	Day 4 p.m.
Debrief DC/S M&RA	Selected Team Members	Day 4 p.m.

Table 5-21 -- SimMarineCorps Proof of Principle Exercise Schedule

H. SUMMARY

One can see that by the requirements outlined in this chapter, that developing an agent-based business wargame that models the Marine Corps' HRDP is a formidable task. It requires significant understanding of the numerous processes resident within the HRDP. It also requires the identification, collection, and validation of a great deal of relevant data. The development of SimMarineCorps, although challenging, has been helped substantially by the experience gained from the U.S. Army's version of a business wargame, Firm Handshake. This two day exercise brought forth many lessons learned, which have been incorporated in

the form of developmental and design improvements. These improvements should enhance the gaming experience and improve the probability of achieving "Aha" experiences that will increase participant insight and awareness of the interplay among the various Marine Corps' HRDP functional areas, and the value of adopting a systems perspective towards policy and decision-making within the HRDP.

VI. SUMMARY AND CONCLUSIONS

A. SUMMARY

The objective of this thesis was to examine the phenomenon of complex adaptive systems and how it might be applied to Department of Defense (DoD) policy and decision-making. This was done in support of the Marine Corps' efforts to develop an agent-based simulation. The model described in this thesis will simulate a subset of the business processes within the Marine Corps Human Resource Development Process (HRDP) in order to evaluate various manpower policy decision trądeoffs. The genesis of this effort stemmed from the United States Army's efforts to develop a business wargame called Firm Handshake. Firm Handshake was designed to model the business processes across functional areas within the U.S. Army. Firm Handshake used agent-based simulation to model the manpower processes of manning, recruiting, retention, and training.

To accomplish our objective we first examined simulation within DoD, business wargaming, the application of business wargaming to complex adaptive systems, the use of agent-based simulation to model complex adaptive systems, and then described the Synthetic Environment for Analysis and Simulation (SEAS), which was the environment used in

Firm Handshake. Next we examined the Marine Corps' Human Resource Development Process (HRDP) to identify the key processes and linkages between groups in generating manpower requirements. We then examined the Firm Handshake Proof of Principle Exercise in detail, and from the lessons learned therein, we developed a structure for a Marine Corps version of a business wargame called SimMarineCorps.

B. CONCLUSIONS

It is clear that one means to model a complex adaptive system such as the Marine Corps' HRDP is through the use of agent-based simulation. Several hurdles must be overcome however. These hurdles include generating interest for such a simulation at the General Officer level, understanding the process being modeled (in this case HRDP), generating the requirement or framework for such a simulation, collecting and validating the data and metrics necessary to support the requirements and framework, and finally writing the code for, and calibrating the simulation itself.

All the hurdles above were present in Firm Handshake, yet the proof of principle exercise was successful. It showed that an agent-based simulation of the manpower business processes can be a useful tool for increasing insight into the connectivity between functional areas, and

for taking a systems approach to manpower policies and decisions.

The Marine Corps needs to take advantage of the U.S. Army's experiences with Firm Handshake. Two of the hurdles mentioned above are virtually eliminated by this thesis, namely, understanding the processes to be modeled and generating the requirements and framework to successfully model that process. The most significant remaining hurdle to the *implementation* of SimMarineCorps is the collection/validation of the necessary data/metrics. This thesis provides some, but not all, the data to build the framework for a proof of principle. but by no means provides all the data necessary to complete the development. The most significant obstacle to the *critical success* of SimMarineCorps is the support and participation of General Officers. This was not present in Firm Handshake, which led to a lack of the necessary data/metrics being provided, minimal input by the end-user during the development process, and limited participation during the actual proof of principle exercise by all the functional areas being modeled.

C. RECOMMENDATIONS

1. Ownership of SimMarineCorps

Ownership of SimMarineCorps must not rest with one specific division such as Manpower and Reserve Affairs (M&RA), Marine Corps Recruiting Command (MCRC), or Training and Education (T&E) Division. Ownership must be shared in order to ensure its continuous use and improvement. To ensure this shared ownership, General Officers from each division must be the champion of SimMarineCorps for their respective commands. Recently M&RA created an integration section to improve connectivity within the HRDP. This would be an ideal section to take ownership of such a simulation. Their expertise across the many functional areas, manning, staffing, assigning, retention, and recruiting would assist in the use and further development of the proof of principle on a continuing basis.

2. Future Work

The most important area that future research can address is the validation and collection of data/metrics. Numerous studies and theses are possible that could provide the empirical relationships necessary to fully code the agents within SimMarineCorps. Developing a retention model, analyzing the factors for success in recruiting, and examining the relationships that affect readiness are just a

few of the many areas that need to be explored. Finally, as the Marine Corps changes processes within the HRDP, either from extant policy changes or from lessons learned playing SimMarineCorps, the model and game must be modified accordingly. ABS is feasible; ABS is promising; the Marine Corps can benefit from this technology by adding this new technology to its M&S arsenal.

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APPENDIX A: ORGANIZATIONAL CHARTS FOR THE MARINE CORPS SUPPORTING ESTABLISHMENT

This appendix shows the organization of Headquarters Marine Corps (HQMC)(Figure A.1), Marine Corps Combat Development Command (MCCDC)(Figure A.2), Marine Corps Recruiting Command (MCRC)(Figure A.3), and Marine Corps Material Command (MCMC)(Figure A.4). These are provided to show the environment that the HRDP must operate in, its complexity, and the integration that is necessary in order for it to succeed.

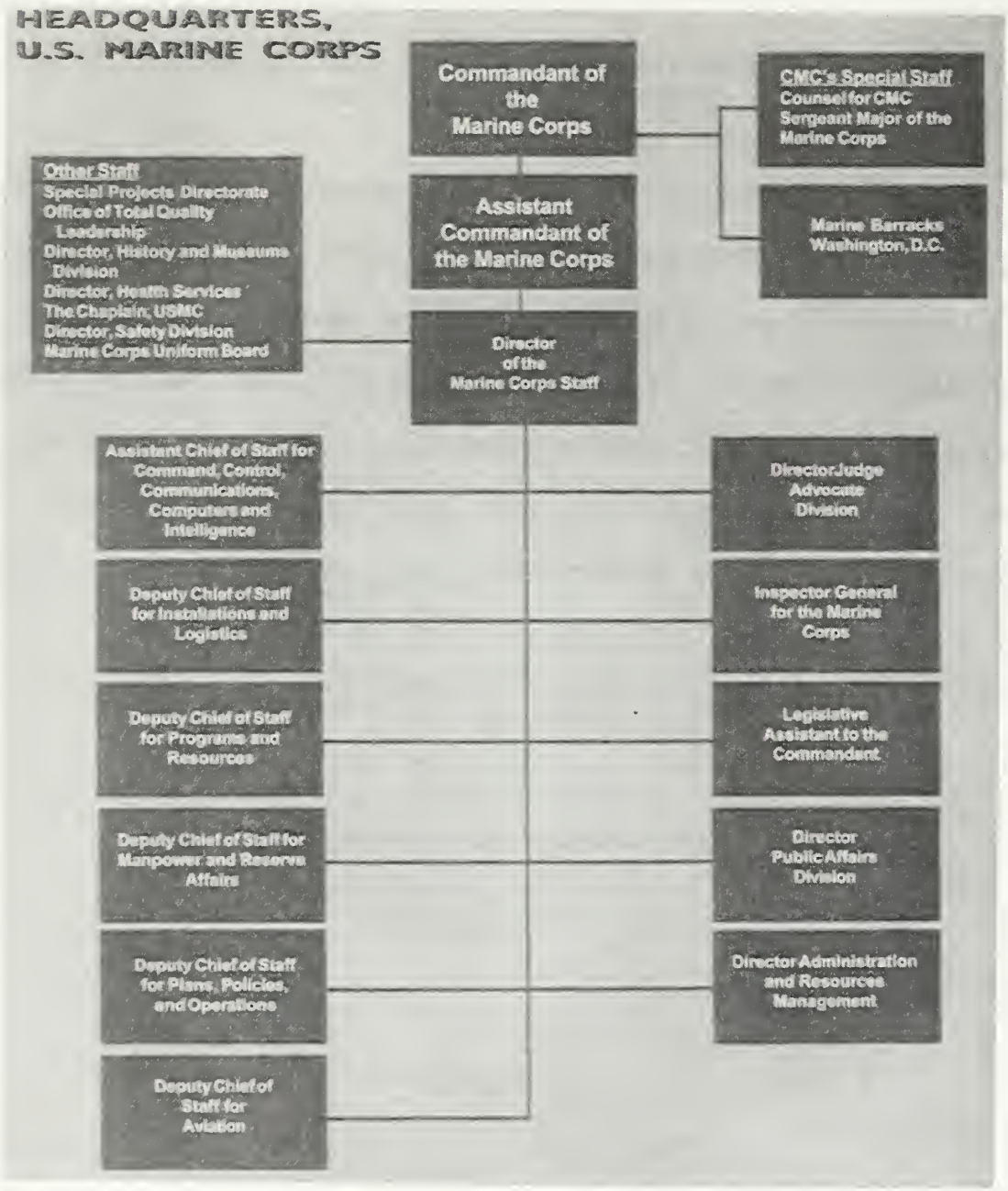

Figure A.1 -- Organization of Headquarters Marine Corps (HQMC)

Figure A.2 -- Organization of Marine Corps Combat Development Command (MCCDC)

Figure A.3 -- Organization of Marine Corps Recruiting Command (MCRC)

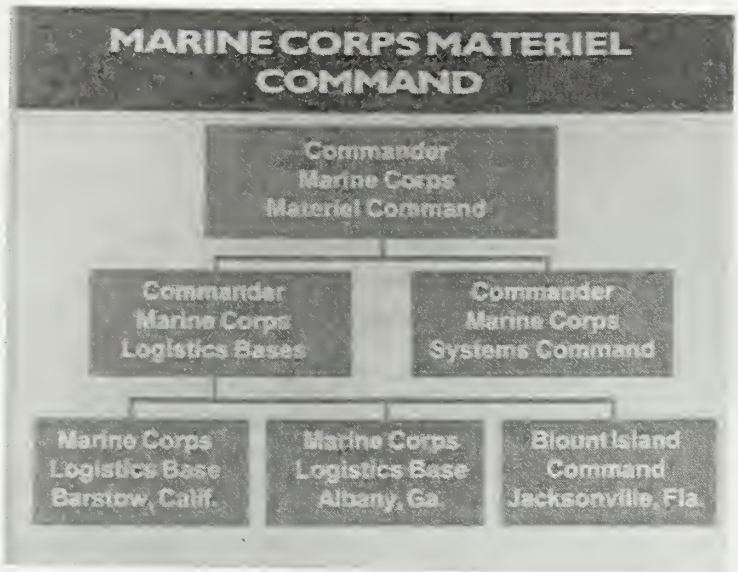

Figure A.4 -- Organization of Marine Corps Material Command (MCMC)

APPENDIX B: INDIVIDUAL MARINE DEMOGRAPHIC INFORMATION

This appendix provides data necessary to code agent attributes as outlined in the data dictionary for individual Marine agents (Table 5-2). Tables B-1 through B-14 show a demographic snapshot of the Marine Corps as of FY1999.

Marine Officer Gender Distribution		
Gender	*Number*	*Percent*
Male	17009	95.0%
Female	888	5.0%
Total	17897	100%

Table B-1 - Marine Officer Gender Distribution by Total Number and Percent (FY1999)[38]

Marine Officer Grade Distribution		
Grade	*Number*	*Percent*
WO-1	241	1.3%
CWO-2	790	4.4%
CWO-3	476	2.7%
CWO-4	246	1.4%
CWO-5	86	0.5%
O-1 (2ndLt)	2590	14.5%
O-2 (1stLt)	2657	14.8%
O-3 (Capt)	4946	27.6%
O-4 (Maj)	3402	19.0%
O-5 (LtCol)	1763	9.9%
O-6 (Col)	620	3.5%
O-7 - O-10 (Gen)	80	0.4%
Total	17897	100%

Table B-2 - Marine Officer Grade Distribution by Total Number and Percent (FY1999)[39]

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[38] Source: Manpower and Reserve Affairs (M&RA) (As of end of FY 1999)

[39] Ibid.

Marine Officer Age Distribution		
Age	*Number*	*Percent*
22	297	1.7%
23	498	2.8%
24	689	3.8%
25	916	5.1%
26	1008	5.6%
27	1061	5.9%
28	1137	6.4%
29	1081	6.0%
30	1027	5.7%
31-35	3909	21.8%
36-40	3092	17.3%
41+	3182	17.8%
Total	17897	100%

Table B-3 - Marine Officer Age Distribution by Number and Percent (FY1999)[40]

Marine Officer Families				
	Spouses	*Children*	*Parents & Others*	*Total*
Officers	12172	19636	51	31859

Table B-4 - Marine Officer Families (Dependents) (FY1999)[41]

[40] Ibid.

[41] Ibid.

Marine Officer Racial Distribution									
	White		*Black*		*Hispanic*		*Other*		
Grade	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Total*
WO/CWO	1340	64	239	29	114	8	39	6	1839
O-1	1874	151	191	33	180	18	123	20	2590
O-2	1985	162	202	16	161	11	107	13	2657
O-3	4042	163	306	20	249	7	152	7	4946
O-4	2956	75	161	10	103	0	92	5	3402
O-5	1582	50	60	6	37	1	27	0	1763
O-6	559	11	30	1	15	0	4	0	620
O-7 - O-10	74	1	3	0	2	0	0	0	80
Total	14412	677	1192	115	861	45	544	51	17897

Table B-5 – Marine Officer Racial Distribution by Race and Gender (FY1999)[42]

Marine Officer Gender by Grade					
Grade	*Male#*	*Male%*	*Female#*	*Female%*	*Total%*
WO-1	230	95.4%	11	4.6%	100%
CWO-2	734	92.9%	56	7.1%	100%
CWO-3	449	94.3%	27	5.7%	100%
CWO-4	237	96.3%	9	3.7%	100%
CWO-5	82	95.3%	4	4.7%	100%
O-1 (2ndLt)	2368	91.4%	222	8.6%	100%
O-2 (1stLt)	2455	92.4%	202	7.6%	100%
O-3 (Capt)	4749	96.0%	197	4.0%	100%
O-4 (Maj)	3312	97.4%	90	2.6%	100%
O-5 (LtCol)	1706	96.8%	57	3.2%	100%
O-6 (Col)	608	98.1%	12	1.9%	100%
O-7 - O-10 (Gen)	79	98.8%	1	1.2%	100%
Total	17009		888		

Table B-6 -- Marine Officer Gender by Grade by Number and Percent (FY1999)[43]

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[42] Ibid.

[43] Ibid.

Marine Officer Military Occupational Field Distribution			
Occ Field	*Male*	*Female*	*Total*
01	527	149	676
02	748	43	791
03	2139	0	2139
04	1221	122	1343
06	749	63	812
08	876	0	876
11	30	2	32
13	492	25	517
18	345	0	345
21	124	3	127
23	99	0	99
25	31	2	33
26	31	1	32
28	135	6	141
30	590	60	650
31	28	3	31
33	38	4	42
34	302	56	358
35	92	5	97
40	37	0	37
41	11	4	15
43	94	25	119
44	387	34	421
46	15	2	17
55	10	2	12
57	102	1	103
58	194	11	205
59	69	3	72
60	368	21	389
63	133	0	133
64	0	0	0
65	91	1	92
66	211	18	229
68	31	0	31
70	36	1	37
72	549	47	596
73	19	0	19
75	4832	73	4905
84	0	0	0
98	15	0	15
99	1208	101	1309
Total	17009	888	17897

Table B-7 - Marine Officer Occupational Field Distribution by Gender (FY1999)[44]

[44] Ibid.

Marine Enlisted Gender Distribution		
Gender	*Number*	*Percent*
Male	145475	94.0%
Female	9269	6.0%
Total	154744	100%

Table B-8 -- Marine Enlisted Gender Distribution by Total Number and Percent (FY1999)[45]

Marine Enlisted Grade Distribution		
Grade	*Number*	*Percent*
E-1 (Pvt)	13514	8.73%
E-2 (Pfc)	21039	13.60%
E-3 (LCpl)	41785	27.00%
E-4 (Cpl)	28218	18.24%
E-5 (Sgt)	22742	14.70%
E-6 (SSgt)	13872	8.96%
E-7 (GySgt)	8995	5.81%
E-8 (1stSgt/MSgt)	3349	2.16%
E-9 (SgtMaj/MgySgt)	1230	0.79%
Total	154744	100%

Table B-9 - Marine Enlisted Grade Distribution by Total Number and Percent (FY1999)[46]

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[45] Ibid.

[46] Ibid.

Marine Enlisted Age Distribution		
Age	*Number*	*Percent*
17	517	0.3%
18	9419	6.1%
19	17485	11.3%
20	20273	13.1%
21	20265	13.1%
22	16816	10.9%
23	11082	7.2%
24	8316	5.4%
25	6687	4.3%
26-30	19909	12.9%
31-35	11229	7.3%
36-40	9272	6.0%
41+	3474	2.2%
Total	154744	100%

Table B-10 - Marine Enlisted Age Distribution by Number and Percent (FY1999)[47]

Marine Enlisted Families				
	Spouses	*Children*	*Parents & Others*	*Total*
Enlisted	58297	79032	279	137608

Table B-11 - Marine Enlisted Families (Dependents) (FY1999)[48]

[47] Ibid.

[48] Ibid.

Marine Enlisted Racial Distribution									
	White		*Black*		*Hispanic*		*Other*		
Grade	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Total*
E-1	8865	380	1831	130	1635	95	536	42	13514
E-2	13540	803	2485	251	2727	212	928	93	21039
E-3	26248	1573	5271	580	5460	454	1996	203	41785
E-4	18043	1026	3379	371	3733	280	1281	105	28218
E-5	14115	660	3678	336	2763	184	919	87	22742
E-6	8260	319	3218	273	1201	90	471	40	13872
E-7	5353	249	2219	171	701	38	249	15	8995
E-8	1819	90	966	56	280	23	109	6	3349
E-9	709	19	347	12	100	1	40	2	1230
Total	96952	5119	23394	2180	18600	1377	6529	593	154744

Table B-12 - Marine Enlisted Racial Distribution by Race and Gender (FY1999)[49]

Marine Enlisted Gender by Grade					
Grade	*Male#*	*Male%*	*Female#*	*Female%*	*Total%*
E-1 (Pvt)	12867	95.2%	647	4.8%	100%
E-2 (Pfc)	19680	93.5%	1359	6.5%	100%
E-3 (LCpl)	38975	93.3%	2810	6.7%	100%
E-4 (Cpl)	26436	93.7%	1782	6.3%	100%
E-5 (Sgt)	21475	94.4%	1267	5.6%	100%
E-6 (SSgt)	13150	94.8%	722	5.2%	100%
E-7 (GySgt)	8522	94.7%	473	5.3%	100%
E-8 (1stSgt/MSgt)	3174	94.8%	175	5.2%	100%
E-9 (SgtMaj/MgySgt)	1196	97.2%	34	2.8%	100%
Total	145475		9269		

Table B-13 -- Marine Enlisted Gender by Grade by Number and Percent (FY1999)[50]

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[49] Ibid.

[50] Ibid.

Marine Enlisted Military Occupational Field Distribution			
Occ Field	*Male*	*Female*	*Total*
01	7685	1176	8861
02	1674	119	1793
03	25625	0	25625
04	2773	343	3116
06	194	37	231
08	3376	0	3376
11	2490	193	2683
13	6719	210	6929
18	2148	0	2148
21	3449	80	3529
23	1332	130	1462
25	8011	725	8736
26	1695	220	1915
28	4034	145	4179
30	6371	884	7255
31	523	87	610
33	2831	423	3254
34	1170	204	1374
35	10672	639	11311
40	1730	110	1840
41	122	11	133
43	313	87	400
44	437	111	548
46	469	67	536
55	590	116	706
57	637	31	668
58	3430	267	3697
59	1271	67	1338
60	8090	393	8483
61	4976	120	5096
63	3336	197	3533
64	2623	159	2782
65	2238	190	2428
66	1464	291	1755
68	273	33	306
70	2042	171	2213
72	1807	112	1919
73	249	7	256
84	397	8	405
98	172	46	218
99	16037	1060	17097
Total	145475	9269	154744

Table B-14 - Marine Enlisted Occupational Field Distribution by Gender (FY1999)[51]

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[51] Ibid.

APPENDIX C: OPERATING FORCES ORGANIZATION AND TABLES OF ORGANIZATION (T/O'S)

This section shows the organization of Marine Corps Ground (CE, GCE, and CSSE) and Aviation (ACE) units by location, Atlantic (LANT) and Pacific (PAC) (Figures C.1 and C.2). It further lists the sub-units down to the battalion/squadron level for ground and aviation units by location, LANT and PAC, and base (Tables C-1, C-2, C-3, and C-4). This also shows a sample of a Marine Corps' T/O&E. T/O&E's can be obtained from CG, MCCDC, Total Force Division (TFS), and upon permission from TFS are available online at [http://www.mccdc.usmc.mil/tfs/]. Finally, Figure C.3 shows the initial distribution of readiness based on the SORTS P-rating.

A. MARINE CORPS GROUND AND AVIATION UNITS ORGANIZATION

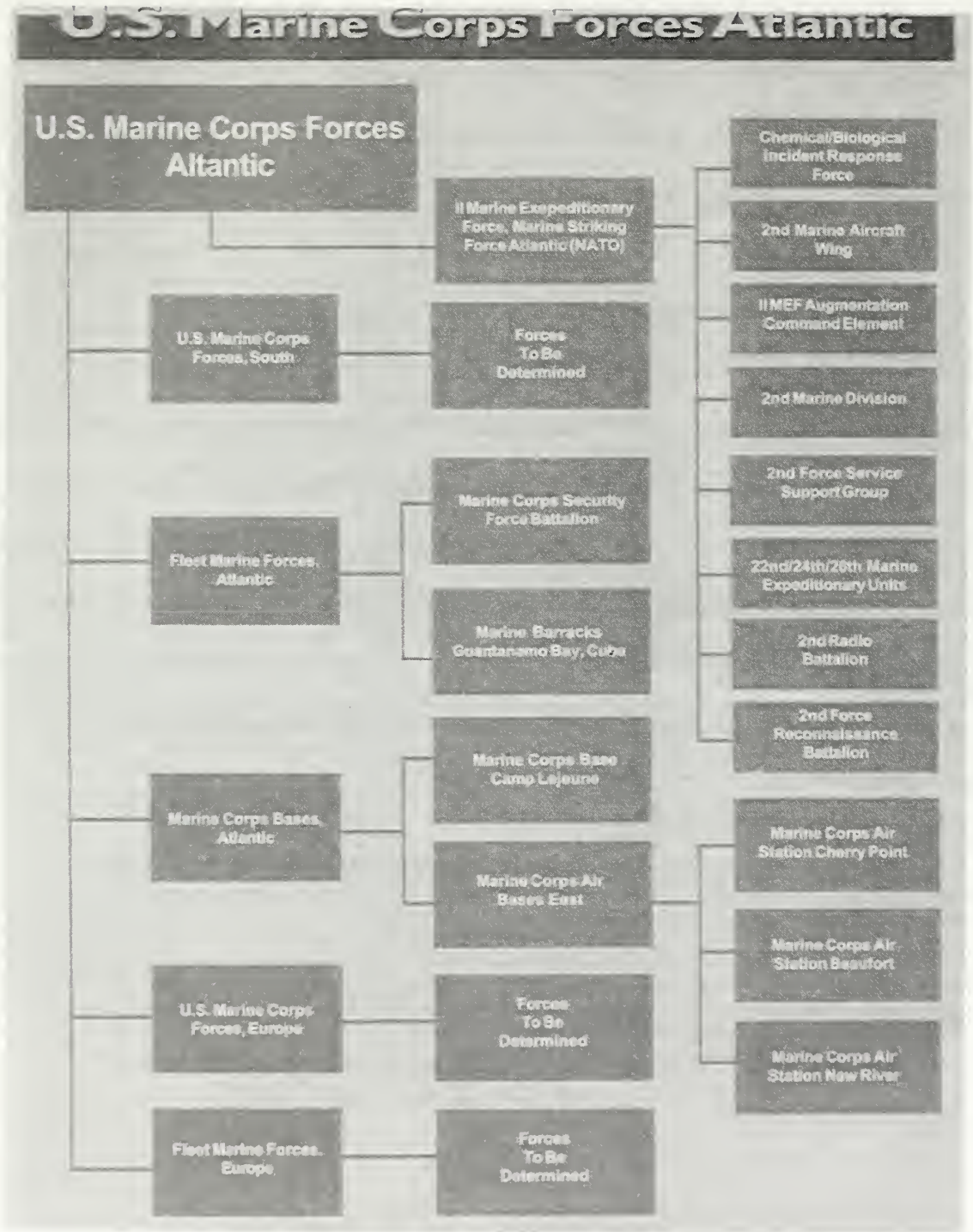

Figure C.1 - Organization of U.S. Marine Forces Atlantic (MARFORLANT)

Active Ground Units (MARFORLANT)	
Base/Location	***Units***
Marine Corps Combat Development Command (MCCDC), Quantico, VA.	Experimental Special Purpose Marine Air Ground Task Force (ESPMAGTF)
Marine Corps Base (MCB) Camp Lejune, N.C.	II Marine Expeditionary Force (MEF) Command Element (CE)
	22nd Marine Expeditionary Unit (MEU) CE
	24th MEU CE
	26th MEU CE
	2nd Force Service Support Group (FSSG)
	Headquarters & Service (H&S) Battalion (Bn)
	2nd FSSG (Forward (FWD))
	2nd Medical Bn
	2nd Dental Bn
	2nd Supply Bn
	2nd Maintenance Bn
	2nd Landing Support Bn
	8th Engineer Support Bn
	8th Maintenance Bn
	8th Motor Transport Bn
	MEU Service Support Group (MSSG) - 22
	MSSG - 24
	MSSG - 26
	Combat Service Support (CSS) Detachment (Det) - 21
	CSS - 23
	CSS - 27
	2nd Marine Division (MARDIV)
	2nd Marine Regiment (Regt)
	- 1st Bn (1/2)
	- 2nd Bn (2/2)
	- 3rd Bn (3/2)
	6th Marine Regt
	- 1st Bn (1/6)
	- 2nd Bn (2/6)
	- 3rd Bn (3/6)
	8th Marine Regt
	- 1st Bn (1/8)
	- 2nd Bn (2/8)
	- 3rd Bn (3/8)
	10th Marine Regt
	- 1st Bn (1/10)
	- 2nd Bn (2/10)
	- 3rd Bn (3/10)
	- 5th Bn (5/10)
	2nd Tank Bn
	2nd Assault Amphibian (AA) Bn
	2nd Light Armored Reconnaissance (LAV) Bn
	2nd Combat Engineer Bn (CEB)
	2nd Reconnaissance Bn

Table C-1 – MARFORLANT Active Marine Corps Ground Units by Base/Location

Active Aviation Units (MARFORLANT)	
Base/Location	*Units*
Marine Corps Air Station (MCAS) Cherry Point, N.C.	Headquarters, 2nd Marine Aircraft Wing (MAW)
	Marine Wing Headquarters Squadron (MWHS-2)
	Commander Air Bases East (COMCABEAST)
	Marine Air Group (MAG) - 14
	Marine Air Logistics Squadron(MALS)-14
	Marine Fixed Wing Electronic Warfare Squadron (VMAQ) -1
	VMAQ -2
	VMAQ -3
	VMAQ -4
	Marine Fixed Wing Attack Training Squadron (VMAT) -203
	Marine Fixed Wing Attack Squadron (VMA) -223
	VMA -231
	VMA -542
	Marine Fixed Wing Refueling Squadron (VMGR) - 252
	Marine Fixed Wing Refueling Training Squadron (VMGRT) -253
	Marine Fixed Wing Unmanned Aerial Vehicle Squadron (VMU) -2
	Marine Air Control Group (MACG) -28
	Marine Tactical Air Control Squadron (MTACS) -28
	Marine Wing Communications Squadron (MWCS) -28
	Marine Air Control Squadron(MACS)-2
	Marine Air Support Squadron(MASS)-1
	2nd Light Anti-Air Defense (LAAD) Bn
	Marine Wing Support Group (MWSG) -27
	Marine Wing Support Squadron (MWSS)-27
	Air Tactical Control (ATC) Det
Bogue Airfield, N.C.	MWSS-271
	ATC Det
MCAS New River, N.C.	MAG-26
	MALS-26
	Marine Medium Helicopter Squadron(HMM)-261
	HMM -264
	HMM -266
	Marine Heavy Helicopter Squadron(HMH)-461
	Marine Light Attack Helicopter Squadron (HMLA) -167
	Marine Medium Vertical (MV-22) Training Squadron (VMMT)-204
	MAG-29
	MALS-29
	HMM-162
	HMM-263
	HMM-365
	HMH-464
	HMLA-269
	VMMT-302
	MWSS-272
	ATC Det
MCAS Beaufort, S.C.	MAG-31
	MALS-31
	Marine Fixed Wing Fighter Attack Squadron (VMFA) -115
	VMFA -122
	VMFA -251
	VMFA -312
	VMFA All Weather (AW) -224
	VMFA (AW) -332
	VMFA (AW) -533
	MWSS -273
	ATC Det

Table C-2 - MARFORLANT Active Marine Corps Aviation Units by Base/Location

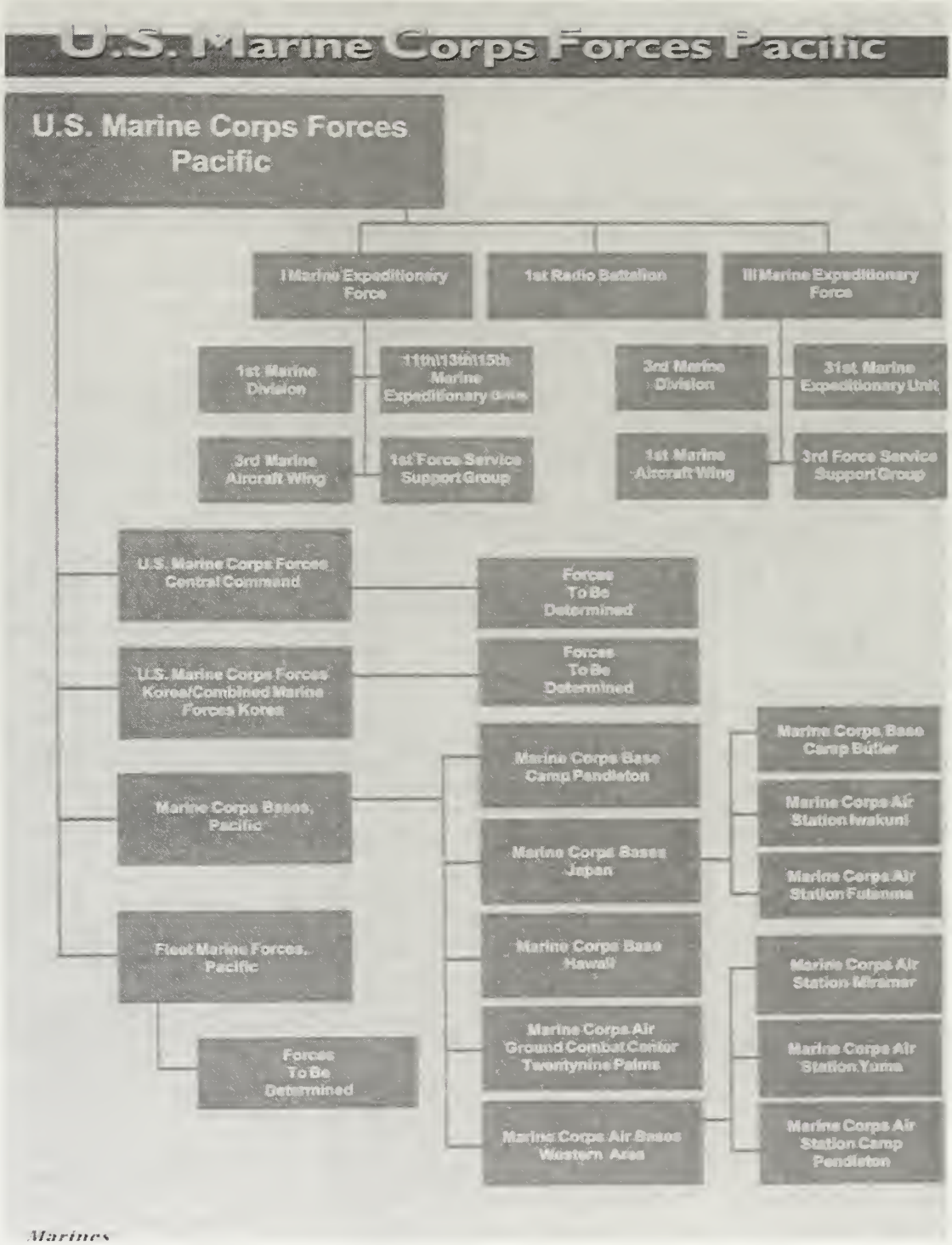

Figure C.2 - Organization of U.S. Marine Forces Pacific (MARFORPAC)

Active Ground Units (MARFORPAC)	
Base/Location	*Units*
MCB Camp Pendleton, CA	I Marine Expeditionary Force (MEF) Command Element (CE)
	11th Marine Expeditionary Unit(MEU)CE
	13th MEU CE
	15th MEU CE
	1st Force Reconnaissance Company
	1st Force Service Support Group (FSSG)
	Headquarters & Service (H&S) Battalion (Bn)
	1st FSSG (Forward (FWD))
	1st Medical Bn
	1st Dental Bn
	1st Supply Bn
	1st Maintenance Bn
	1st Landing Support Bn
	7th Engineer Support Bn
	7th Maintenance Bn
	MEU Service Support Group(MSSG)-11
	MSSG - 13
	MSSG - 15
	Combat Service Support (CSS) Detachment (Det) - 14
	CSS - 16
	1st Marine Division (MARDIV)
	1st Marine Regiment (Regt)
	- 1st Bn (1/1)
	- 2nd Bn (2/1)
	- 3rd Bn (3/1)
	- 1st Bn, 4th Marine Regt(1/4)
	5th Marine Regt
	- 1st Bn (1/5)
	- 2nd Bn (2/5)
	- 3rd Bn (3/5)
	- 2nd Bn, 4th Marine Regt(2/4)
	11th Marine Regt
	- 1st Bn (1/11)
	- 2nd Bn (2/11)
	- 5th Bn (5/10)
	3rd Assault Amphibian (AA) Bn
	1st Light Armored Reconnaissance (LAV) Bn
	1st Combat Engineer Bn (CEB)
	1st Division Reconnaissance Company
Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA	7th Marine Regt
	- 1st Bn (1/7)
	- 2nd Bn (2/7)
	- 3rd Bn (3/7)
	- 3rd Bn, 4th Marine Regt(3/4)
	11th Marine Regt
	- 3rd Bn (3/11)
	1st Tank Bn
	3rd AA Bn
	- Company D
	Combat Service Support Group (CSSG) -1
	3rd LAV Bn
MCB Kaneohe Bay, HI	Marine Forces Pacific
	3rd Marine Regiment (Regt)
	- 1st Bn (1/3)
	- 2nd Bn (2/3)

	- 3rd Bn (3/3)
	1st Bn, 12th Marine Regt (1/12)
	CSSG-3
	1st Radio Bn
Okinawa, Japan	III MEF
	3rd Marine Division
	4th Marine Regt
	- 2 Unit Deployment Program (UDP) Bn's
	12th Marine Regt
	- Headquarter Battery 3rd Bn (3/12)
	31st MEU
	- CE
	- 2 UDP Bn's
	Combat Assault Bn
	- 1 UDP Bn
	LAV Company
	- 1 AA Company
	5th Force Reconnaissance Company
	3rd FSSG (Reinforced)
	- H&S Bn
	- 3rd Medical Bn
	- 3rd Dental Bn
	- 3rd Supply Bn
	- 3rd Support Bn
	- 3rd Maintenance Bn
	- 3rd Landing Support Bn
	- 9th Engineer Support Bn
	- MSSG-31
	- CSS Det-36 (Iwakuni, Japan)
	- CSS Det-76 (Camp Fuji, Japan)

Table C-3 - MARFORPAC Active Marine Corps Ground Units by Base/Location

Active Aviation Units (MARFORPAC)	
Base/Location	***Units***
Marine Corps Air Station (MCAS) Futenma, Okinawa, Japan	1st Marine Aircraft Wing (MAW)
	Headquarters (HQ), 1st MAW
	- Marine Wing HQ Squadron (MWHS)-1
	Marine Air Group (MAG)-36
	- Marine Air Logistics Squadron (MALS)-36
	- Marine Medium Helicopter Squadron (HMM)-262
	- HMM-265
	- Marine Heavy Helicopter Squadron (HMH)- Pacific (PAC) (Unit Deployment Program (UDP))
	- Marine Light Attack Helicopter Squadron (HMLA)-PAC (UDP)
	- Marine Fixed Wing Refueling Squadron(VMGR)-152
	Marine Air Control Group (MACG)-18
	- Marine Air Tactical Control Squadron (MATCS)-18
	- Marine Wing Communications Squadron (MWCS)-18 (minus(-))
	- Marine Air Control Squadron (MACS)-4
	- Air Traffic Control (ATC) Detachment (Det)
	-Marine Air Support Squadron (MASS)-2
	- 1st Stinger Battery
	- Marine Wing Support Squadron (MWSS)-172
Camp Foster, Okinawa, Japan	Marine Wing Support Group (MWSG)-17
MCAS IWAKUNI, Japan	MAG-112
	- MALS-12
	- Marine Fixed Wing Fighter Attack Squadron (VMFA)(All Weather (AW))-Atlantic(LANT)(UDP)
	- VMFA-212
	- VMFA(AW)-PAC (UDP)
	- Marine Fixed Wing Electronic Warfare Squadron (VMAQ)-LANT
	-MWSS-171
	- ATC Det
Marine Corps Base (MCB) Kaneohe Bay, Hawaii	1st MAW Aviation Support Element
	- MALSE
	- Marine Medium Helicopter Training Squadron (HMT)-301
	- HMH-362
	- HMH-363
	- HMH-366
	- HMH-463
MCAS Miramar, CA	3rd MAW
	- HQ, 3rd MAW
	- MWHS-3
	MAG-11
	- MALS-11
	- VMFA-232
	- VMFA-314
	- VMFA(AW)-121
	- VMFA(AW)-225
	- VMFA(AW)-242
	- VMFAT-101
	- VMGR-352
	MAG-16
	- MALS-16
	- HMM-161
	- HMM-163
	- HMM-165
	- HMH-166
	- HMH-361
	- HMH-462
	- HMH-465
	- HMH-466
	MWSG-37
	- MWSS-373
	MACG-38
	- MWCS-38
	- MTACS-38
	- 2 ATC Dets
MCAS Yuma, AZ	MAG-13
	- MALS-13
	- Marine Fixed Wing Attack Squadron (VMA)-211
	- VMA-214
	- VMA-311

	- VMA-513
	MWSS-371
	MACS-7
	- Targeting and Missile Defense (TMD) Det
	- ATC Det
	Marine Air Weapons and Tactics Squadron (MAWTS)-1
MCAS Camp Pendleton, CA	MAG-39
	- MALS-39
	- HMLA-169
	- HMLA-267
	- HMLA-367
	- HMLA-369
	- HMT-164
	- HMM-268
	- HMM-364
	- HMT-303
	MWSS-372
	MACS-1
	- ATC Det
	MASS-3
	3rd Light Anti-Air Defense (LAAD) Bn
Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, CA	Air-Ground Support Element
	Marine Fixed Wing Unmanned Aerial Vehicle Squadron (VMU)-1
	MWSS-374

Table C-4 – MARFORPAC Active Marine Corps Aviation Units by Base/Location

B. SAMPLE MARINE CORPS TABLE OF ORGANIZATION AND EQUIPMENT (T/O&E)

REPORT NO. I5921C4A-1
PAGE: 5809
AS OF: 99/10 (OCT 99 TROOP LIST)
PREPARED: 99/10/04

TABLE OF MANPOWER REQUIREMENTS

MISSION STATEMENT FOR T/O 4710E

**4710E 23 MARCH 1995

TABLE OF ORGANIZATION NUMBER.....4710E

MARINE CORPS IMAGERY SUPPORT UNIT
FLEET MARINE FORCE
CAMP PENDLETON, CA

1. PROMULGATION STATEMENT. THIS TABLE OF ORGANIZATION PRESCRIBES THE ORGANIZATIONAL STRUCTURE, BILLET AUTHORIZATION, PERSONNEL STRENGTH, AND INDIVIDUAL WEAPONS FOR THE MARINE CORPS IMAGERY SUPPORT UNIT (MCISU), FLEET MARINE FORCE (FMF).

2. ORGANIZATION

HEADQUARTERS SECTION
EXPLOITATION TEAM

3. MISSION AND TASKS

A. MISSION. TO PROVIDE IMAGERY ANALYSIS SUPPORT FOR THE FMF, MARINE EXPEDITIONARY FORCES (MEF) AND SUBORDINATE MARINE AIR-GROUND TASK FORCES (MAGTF'S), MARINE CORPS SUPPORTING ESTABLISHMENT, AND OTHER COMMANDS AS DIRECTED.

B. TASKS

(1) SUPPORT AND ASSIST THE EXECUTIVE AGENT, THE ASSISTANT CHIEF OF STAFF, C4I HQMC (AC/S C4I) IN ALL MATTERS PERTAINING TO IMAGERY EXPLOITATION, EMPLOYMENT OF MCISU, AND THE MAINTENANCE OF ALL ORGANIC IMAGERY AND IMAGERY-RELATED EQUIPMENT.

(2) EXPLOIT AND ANALYZE NATIONAL IMAGERY TO DERIVE INTELLIGENCE PERTAINING TO INSTALLATIONS, DISPOSITION, STRENGTH, AND ACTIVITIES OF VARIOUS CONVENTIONAL AND NON-CONVENTIONAL FORCES. CONDUCT EXPLOITATION AND RELATED TASKS IN RESPONSE TO DIRECTION FROM THE EXECUTIVE AGENT.

(3) PROVIDE IMAGERY REPORTS, LIMITED IMAGERY-DERIVED PRODUCTS, AND LIMITED SECONDARY IMAGERY TO THE MAGTF COMMANDER AND OTHERS AS DIRECTED.

(4) CONDUCT LIAISON WITH THE FORCE IMAGERY INTERPRETATION UNITS FOR THE PURPOSE OF PROVIDING NATIONAL IMAGERY PRODUCTS TO SUPPORT THE MAGTF COMMANDER.

(5) CONDUCT LIAISON WITH NATIONAL PROGRAM OFFICES AS REQUIRED TO SUPPORT DAY-TO-DAY UNIT ACTIVITIES.

(6) MANAGE, UPDATE, AND MAINTAIN NATIONAL DATA BASES AS REQUIRED TO SUPPORT PRODUCTION RESPONSIBILITIES AND DAILY OPERATIONS.

4. CONCEPT OF ORGANIZATION. THE MCISU IS UNDER THE ADMINISTRA-

MISSION STATEMENT FOR T/O 4710E

TIVE CONTROL OF HEADQUARTERS AND SUPPORT BATTALION (HQSPTBN), MARINE CORPS BASE, CAMP PENDLETON (MCB CAMPEN). THE MCISU CONSISTS OF A HEADQUARTERS SECTION AND ONE EXPLOITATION TEAM.

A. COMMAND AND CONTROL

(1) COMMAND AND CONTROL. THE OFFICER IN CHARGE (OIC), MCISU, EXERCISES COMMAND OF THE MCISU THROUGH THE EXPLOITATION MANAGERS. ADMINISTRATIVE CONTROL OF THE MCISU IS THROUGH THE COMMANDING OFFICER, HQSPTBN, MCB, CAMPEN. THE REPORTING SENIOR FOR THE OIC, MCISU WILL BE HEAD, COUNTER INTELLIGENCE PERSONNEL BRANCH AND THE REVIEWING OFFICER WILL BE HEAD, COUNTER INTELLIGENCE DIVISION. OPERATIONAL CONTROL OF THE MCISU IS THROUGH THE EXECUTIVE AGENT, THE AC/S C4I, WHEN NOT TACTICALLY DEPLOYED.

(2) COMMUNICATIONS. THE MCISU HAS A LIMITED AMOUNT OF COMMUNICATIONS EQUIPMENT AND WILL REQUIRE COMMUNICATIONS SUPPORT FROM THE SUPPORTED COMMAND. COMMUNICATIONS CIRCUITS REQUIRED BY THE MCISU WILL BE DESIGNATED AS TSP-01 CIRCUITS. THERE ARE NO COMMUNICATIONS PERSONNEL ORGANIC TO THE MCISU.

B. FIREPOWER. ORGANIC FIREPOWER IS LIMITED TO INDIVIDUAL WEAPONS.

C. MOBILITY. THE MCISU HAS NO ORGANIC TRANSPORTATION. GROUND MOBILITY IS PROVIDED BY THE SUPPORTED COMMAND IF AND WHEN THE UNIT IS DEPLOYED. ASSETS REQUIRED FOR THE TRANSPORTATION OF MCISU EQUIPMENT ARE NOT ORGANIC TO THE MEF, REQUIRING AUGMENTATION FROM EXTERNAL AGENCIES WHEN THE UNIT DEPLOYS.

5. CONCEPT OF EMPLOYMENT

A. THE MCISU HAS THE CAPABILITY TO SIMULTANEOUSLY SUPPORT THE FMF AND THE SUPPORTING ESTABLISHMENT; AND WILL OPERATE 24 HOURS A DAY, SEVEN DAYS A WEEK. SUPPORT WILL NORMALLY BE PROVIDED FROM THE MCISU GARRISON LOCATION, AND IF REQUIRED TO DEPLOY, WILL SUPPORT A SINGLE MAGTF, OR OTHER COMMAND AS DIRECTED. THE MCISU WILL REQUIRE SUPPORT FROM THE COMMAND ELEMENT TO WHICH ASSIGNED.

B. THE OIC, MCISU IS RESPONSIBLE FOR THE TRAINING, MAINTENANCE, AND EMPLOYMENT OF THE MCISU IN SUPPORT OF MAGTF'S OR OTHER DESIGNATED COMMANDERS.

6. ADMINISTRATIVE CAPABILITIES. THE MCISU IS NOT CAPABLE OF SELF-ADMINISTRATION. ADMINISTRATIVE SUPPORT OF PERSONNEL FUNCTIONS IS PROVIDED BY HQSPTBN, MCB, CAMPEN.

7. LOGISTIC CAPABILITIES

A. MAINTENANCE

(1) THE MCISU IS AUTHORIZED TO PERFORM 1ST THROUGH 4TH

MISSION STATEMENT FOR T/O 4710E

ECHELON MAINTENANCE OF ORGANIC IMAGERY EQUIPMENT.

(2) THE MCISU IS CAPABLE OF 1ST ECHELON MAINTENANCE OF ALL OTHER ORGANIC EQUIPMENT.

(3) SECOND ECHELON MAINTENANCE SUPPORT OF ALL NON-IMAGERY EQUIPMENT EMPLOYED BY THE MCISU IS PROVIDED BY THE HQSPTBN, MCB, CAMPEN, OR THE SUPPORTED UNIT.

B. SUPPLY

(1) SUPPLY SUPPORT OF THE MCISU IS PROVIDED BY THE HQSPTBN, MCB, CAMPEN, OR THE SUPPORTED UNIT.

(2) IMAGERY ANALYSIS EQUIPMENT THAT IS DESIGNATED AS FORCE ACTIVITY DESIGNATOR I (FAD/I) AND CRITICAL LOW DENSITY (CLD) EQUIPMENT, WILL HAVE FAD/I AND CLD SUPPLY SUPPORT PROVIDED BY HQSPTBN, MCB, CAMPEN, OR THE SUPPORTED COMMAND IN ACCORDANCE WITH CURRENT JOINT SERVICE DIRECTIVES AND MARINE CORPS POLICY REGARDING FAD/I AND CLD EQUIPMENT.

C. TRANSPORTATION. TRANSPORTATION SUPPORT IS REQUIRED TO DISPLACE ALL ELEMENTS OF THE MCISU.

D. GENERAL ENGINEERING. NONE.

E. HEALTH SERVICES. MEDICAL SUPPORT IS PROVIDED BY HQSPTBN, MCB, CAMPEN, OR THE SUPPORTED UNIT.

F. SERVICES. SERVICES SUPPORT IS PROVIDED BY HQSPTBN, MCB, CAMPEN.

G. MESSING. MESSING SUPPORT IS PROVIDED BY HQSPTBN, MCB, CAMPEN.

8. SUPERSESSION. NONE. THIS IS A NEW TABLE OF ORGANIZATION AND IS EFFECTIVE UPON RECEIPT.

C. E. MUNDY, JR.
GENERAL, U.S. MARINE CORPS
COMMANDANT OF THE MARINE CORPS

MISSION STATEMENT FOR T/O 4710E

TABLE OF MANPOWER REQUIREMENTS
T/O CHECKLIST

T/O: 4710E MARINE CORPS IMAGERY SUPPORT UNIT
T/E:

LINE NO.	ENGLISH DESCRIPTION	BLT CRD	ALPHA GRADE	MOS	B R N	T Y P	S T A	MARINES OFF	MARINES ENL	MARINES CIV	OTHER SERVICES OFF	OTHER SERVICES ENL	OTHER NON-CHARGEABLE OFF	OTHER NON-CHARGEABLE ENL	OTHER NON-CHARGEABLE CIV	S C C	W P N
1	HEADQUARTERS SECTION																
2	OFFICER IN CHARGE		MAJ	0202	M	O		1									P
3	IMAGERY OPS CHIEF		MGYSGT	0291	M	E			1								P
4	MAINT CHIEF		GYSGT	2821	M	E			1								P
5A	OSO CHIEF/SI ANALYST		CPL	0231	M	E			1								M
	SECTION TOTALS MARINE							1	3								

6	EXPLOITATION TEAM								
7	EXPLOITATION MANAGER	MSGT	0241	M	E	3			P
8	IMAGERY ANALYST	GYSGT	0241	M	E	6			P
9	IMAGERY ANALYST	SSGT	0241	M	E	12			P
10	IMAGERY ANALYST	SGT	0241	M	E	18			M
11	SYSTEM TECH/QA	SSGT	2821	M	E	3			P
I *									
12	SYSTEM TECH	SGT	2821	M	E	3			M
I *									
13	SYSTEM REPAIRMAN	CPL	2818	M	E	6			M
I *									
14	SYSTEM OPERATOR/QA	LCPL	4066	M	E	1			M
I									
15	SYSTEM OPERATOR	SGT	4066	M	E	1			M
I									
	SECTION TOTALS								
	MARINE					53			
16	SI COMMUNICATIONS SECTION								
17	SI COMMUNICATOR	SGT	2651	M	E	1			M
18	SI COMMUNICATOR	CPL	2651	M	E	1			M
	SECTION TOTALS								
	MARINE					2			
	ORGANIZATION TOTALS								
	MARINE					1	58		

FOOTNOTE SECTION
* SEE ADDITIONAL FOOTNOTES

ADDITIONAL FOOTNOTE SECTION

LINE		
4	1	REQUIRES TRAINING ARRANGED THROUGH THR NIS PROGRAM OFFICE.
5A	1	REQUIRES COMPLETION OF THE SSO ADMINISTRATION AND SECURITY COURSE.
11	1	REQUIRES TRAINING ARRANGED THROUGH THE NIS PROGRAM OFFICE.
12	1	REQUIRES TRAINING ARRANGED THROUGH THE NIS PROGRAM OFFICE.
13	1	REQUIRES TRAINING ARRANGED THROUGH THE NIS PROGRAM OFFICE.

INDIVIDUAL WEAPONS

	UONE DESIG NOT APPLIC	AUTO RIFLE	RIFLE	PISTOL	SNUB NOSE	REVOLVER	SQD A WPN
UNARMED							
CHARGEABLE			32	27			
NONCHARGEABLE							

UNIT SUMMARY

	LINE	LINE			MARINES				OTHER SERVICES		NON-CHARGEABLE
UNIT	FROM	TO	PEN	PEN TITLE	MCC	OFF	ENL	CIV	OFF	ENL	OFF ENL CIV
4710E001			0206312M		UH5	1	58				

RECAPITULATION BY MOS

REPORT LINE	GEN E9 SES	COL E8 GS15	LTCOL E7 GS14	MAJ E6 GS13	CAPT E5 GS12	LT E4 GS11	WO E3 GS10	E2/1 GS9	GS8	GS7	GS6	GS5	GS4	GS3	GS2	GS1	LINE

```
      NO.  BMOS
UNGR   EXC  TOTAL
MARINE CHARGEABLE
  MARINE OFFICERS
       1  0202                          1
1
          TOTAL                         1
1
  MARINE ENLISTED
       2  0231                                    1
1
       3  0241            3     6    12    18
39
       4  0291      1
1
       5  2651                               1     1
2
       6  2818                                     6
6
       7  2821                  1     3     3
7
       8  4066                               1           1
2
          TOTAL      1     3     7    15    23     8     1
58
          TOTAL      1     3     7    16    23     8     1
59
TOTAL STRUCTURE
  MARINE OFF                          1
1
  MARINE ENL         1     3     7    15    23     8     1
58
TOTAL REQUIREMENT
  MARINE OFF                          1
1
  MARINE ENL         1     3     7    15    23     8     1
58
GRADE AVERAGE
  MARINE OFFICER    4.00
  MARINE ENLISTED   5.55
  CIVILIAN
```

C. READINESS DISTRIBUTION

Figure C.3 is the recommended distribution of readiness for Marine Corps Units. This distribution is based on percentage of T/O so it mirrors the SORTS P-Rating. We estimate that this distribution is triangular with a low of 70 percent of T/O, a high of 100 percent of T/O, and a mean of 85 percent of T/O.

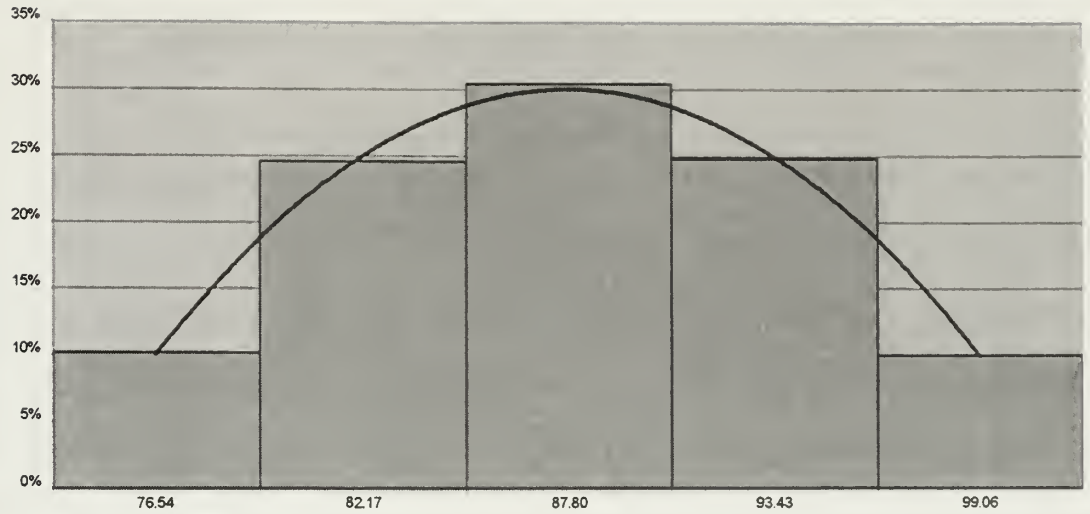

Figure C.3 – Initial Readiness Distribution for Unit Agents in SimMarineCorps as a Percentage of T/O

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APPENDIX D: MANNING DATA AND METRICS

This appendix includes available data not already included in previous chapters and appendices that will support the development of the manning screen. Section A includes information on end strength and the manning budget. Section B provides a model of first-term non-EAS attrition.

A. MANNING DATA

Table D-1 shows the projecting end strength level for FY99-FY05 broken down by grade.

United States Marine Corps							
	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Commissioned Officers	16.0	16.0	16.0	16.0	16.0	16.0	16.1
Warrant Officers	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Enlisted Personnel	154.3	154.3	154.1	154.0	153.7	153.4	153.4
Total	172.2	172.1	172.0	171.9	171.6	171.3	171.2

Table D-1 - Estimated Number of Military Personnel on Active Duty in Thousands for FY99-FY05[52]

Table D-2 shows the manning budget for FY99 and FY00. In the absence of further data, we recommend that percentage

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[52] Office of the Under Secretary of Defense for Personnel and Readiness, *Defense Manpower Requirements Report, Fiscal Year 2000,* p.19, Government Printing Office, Washington, D.C. June 1999

changes between the FY99 and FY00 budget be applied to subsequent budget years to estimate the FY01-07 budgets.

United States Marine Corps		
Cost Categories	***FY1999***	***FY2000***
Basic Pay	3397	3550
Retired Pay Accrual	1024	1137
Basic Allowance for Housing (BAH)	532	555
Subsistence Allowance (in kind cash)	405	420
Incentive Pays	47	50
Special Pays	60	84
Other Allowances	152	165
Separation Pays	69	73
Federal Income Contribution Act	289	271
Permanent Change of Station Travel	227	240
Cadets	0	0
Miscellaneous	45	32
Subtotal	6247	6577
Less Reimbursable	31	31
Total Obligations	6216	6546

Table D-2 - Active Component Military Pay Appropriations ($ Million)[53]

Table D-3 shows the DOPMA Years of Service (YOS) and selection rates by officer pay grade.

DOPMA Targets for Officer YOS and Selection Rate by Grade					
	Officer Grade				
Criterion	***O-3***	***O-4***	***O-5***	***O-6***	***O-7+***
YOS at Promotion	3-5	9-11	15-17	21-23	NA
Selection Rate (%)	100	80	70	50	NA
Note: NA - Data Unavailable					
Source: Officer and Enlisted Personnel Management, Office of the Assistant Secretary of Defense (Personnel and Readiness)					

Table D-3 - Officer DOPMA Targets by Grade, YOS, and Selection Rate(%)

[53] Ibid. pp. 73-74

DOPMA also sets targets for the top two enlisted grades (E-8/9), currently this percentage is 3 percent of total enlisted end strength.[54] Finally the Marine Corps sets its own policy of top six enlisted personnel (E4-E9) as a percentage of total enlisted end strength. Currently, Marine Corps' Top-Six enlisted policy is that grades E-4 to E-9 not exceed 52.2 percent of total enlisted end strength.[55]

B. FIRST TERM NON-EAS ATTRITION MODEL

1. Data

The data for this model is the 1994 enlisted Cohort file obtained from DMDC's Military Entrance Processing Command files. The research includes files from the Marine Corps. DMDC gathers information at the time of accession for all enlistees and then updates the file at the end of each fiscal year with separation and loss information to produce a very extensive file.

The data set was also trimmed down so that the portion used for the analysis contains only fields relevant to our study. The following restriction were imposed on the cohort:

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[54] Habel, Gregg, T., *Manpower 101 Brief,* Presented at the Naval Postgraduate School, 22 October 1999

[55] Ibid.

1. The study uses only non-prior service enlistments.
2. This study is restricted to regular enlistments.
3. This study restricts the entry age to between 17 and 28 years of age.
4. This study uses both male and female enlistments.
5. Attrites in this study were considered to be anyone who leaves the service before their contracted commitment and is assigned an Inter Service Separation Code (ISC) that corresponds to the breaking of the enlistment contract. These codes include unsuitability for service, medical, hardship and erroneous enlistment. They exclude early release, death, retirements, and transfer to other service.
6. This study uses enlistment terms from 1 to 9 years in order to use the broadest range of enlisted cohorts possible. This is particularly important in the case of the Army that has a broad range of enlistment terms.

The number of usable observations for the 1994 Marine Corps service cohort is shown in Table D-4.

Marine Corps 1994 Cohort	
# observations	30,902

Table D-4 -- 1994 Cohort Useable Observations

2. Model and Variable Specification

This paper uses both frequency cross tabulation and logistic regression to analyze the topic. The variables are broken down into one dependent variable and several explanatory variables.

Attrite = f(Age,AFQT,Race,Gender,Education,Moral Waiver)

Where:

- **Attrite:** This is the dependent variable and is defined as anyone who leaves the service prior to their enlistment contract commitment and is assigned an ISC that corresponds to the breaking of their enlistment contract. The study excludes deaths, early releases, retirements (medical and other), and transfers to other service in this variable.
- **Age:** This is continuous variable that indicated the age at time of enlistment. The reference age in the model is 18.
- **AFQT:** This is measured two ways for this study. In the logistic regression models it is a continuous variable that indicates the percentile score of the entrant. The reference percentile in the model is 60. For the purposes of frequency analysis AFQT is broken into dummy variable indicating the mental

group category (CAT I. CAT II, CAT IIIA, CAT IIIB, CAT IV, and CAT V).

- **Race:** the data is broken into the dummy variables, WHITE, BLACK, HISP and OTHER. The base case in the model is WHITE.
- **Gender:** The data is broken into the dummy variables, MALE and FEMALE. The base case in the model is MALE.
- **Education:** The data is broken into the dummy variables NONHSGRD, HSGRAD, SOMECOLL, COLLGRAD, GED, and ALTED. The base case for the model is HSGRAD.
- **Moral Waiver:** The variable MORAL is a dummy variable, which indicates whether or not, and individual has received a moral waiver at the time of enlistment. The category is further broken down by type using the dummy variables, NOWAIVER, TRAFFIC, MINOR (minor non-traffic), MISDEM (misdemeanor), FELONY, DRUG, and ALCOHOL. The base case for the by type breakout is NOWAIVER.

3. Analysis and Results

This section uses logistic regressions to analyze attrition in more detail. Logistic regressions and maximum likelihood techniques are used to determine the probability of first term attrition. The logistic regression returns parameter estimates from which marginal effects of the

explanatory variables can be calculated. To calculate marginal effects we determined a reference observation, calculated its predicted probability of attrition and then increased each explanatory variable by one unit, while holding the others constant. We then compared its predicted probability with the reference observation to determine the marginal effects on the probability of attrition. For this study we used as the reference observation a white male with a high school diploma whose AFQT score = 60 (combined cohort mean), and entry age = 18 (highest frequency of occurrence in the combined cohort). Table D-5 shows parameter estimates of our attrition model and Table D-6 shows the marginal effects.

Variable	Parameter Estimate	(t-Statistic)	Significant .01	Significant .05
Intercept	-1.1580	(7.6773)	YES	YES
AFQTPRCT	-.0110	(15.3391)	YES	YES
ENTRYAGE	.0539	(7.1579)	YES	YES
NONHSGRD	.5097	(2.5641)	NO	YES
SOMECOLL	-.3025	(1.3673)	NO	NO
COLLGRAD	-.7943	(4.3356)	YES	YES
GED	.8452	(10.4323)	YES	YES
ALTED	.5782	(7.5132)	YES	YES
BLACK	-.0218	(.5782)	NO	NO
HISP	-.5749	(13.0213)	YES	YES
OTHER	0	(.0000)	NO	NO
FEMALE	.5489	(10.5539)	YES	YES
MORAL	.1433	(3.6020)	YES	YES
Note: The Model omitted the dummy variables HSGRAD, WHITE, and MALE				

Table D-5 – Parameter Estimates of the First Term Non-EAS Logistic Model

Variable	Marginal Effects
ATTRITE	29.98**
AFQTPRCT	-.33**
ENTRYAGE	1.14**
NONHSGRD	11.64*
SOMECOLL	-5.95
COLLGRAD	-13.77**
GED	19.94**
ALTED	13.31**
BLACK	-.46
HISP	10.57**
OTHER	0.00
FEMALE	12.59**
MORAL	3.09**
Note: The reference observation is AFQTPRCT = 60, ENTRYAGE = 18, HSGRAD, WHITE, MALE, NOWAIVER, and ARRMY	
* Statistically significant at the .05 level ** Statistically significant at the .01 level	

Table D-6 - Marginal Effects of the First Term Non-EAS Logistic Model

APPENDIX E: RETENTION DATA AND METRICS

This appendix provides the available data not already included in the body of this text to support the development of the retention screen. Table E-1 shows the FY00 first term enlisted retention rate in terms of gross number and percentage. Table E-2 shows the expected retention rate by MOS for each level of Selective Reenlistment Bonus (SRB). It further shows the marginal effect of increasing the bonus from one level to another. Tables E-3 to E-8 shows the officer flow management plan for FY99-FY04. Finally, Tables E-9 to E-14 further amplify Tables E-3 to E-8 by showing projected officer retirements by Year of Service (YOS) and pay grade for FY99-FY04.

Marine Corps Enlisted First Term Retention Rate (FY00)	
Total Number	*Retention Rate (%)*
5,788	17.2%
Source: HQMC	

Table E-1 - Marine Corps Enlisted First Retention Rate by Total Number and Percent for FY00

Selective Reenlistment Bonuses for Enlisted Personnel by Occupational Field and Level for FY2000											
Occupational	*SRB Levels*						*Marginal Effect of Increase in SRB level on Continuation rate*				
Field	0	1	2	3	4	5	0-1	1-2	2-3	3-4	4-5
01	35.1%	44.0%	53.3%	62.4%	70.7%	77.8%	8.9%	9.3%	9.1%	8.3%	7.1%
02	8.5%	12.0%	16.5%	22.3%	29.4%	37.7%	3.5%	4.5%	5.8%	7.1%	8.3%
03	8.3%	11.6%	16.0%	21.7%	28.7%	37.0%	3.3%	4.4%	5.7%	7.0%	8.3%
04	14.2%	19.4%	26.0%	33.8%	42.6%	51.9%	5.2%	6.6%	7.8%	8.8%	9.3%
08	10.6%	14.7%	20.0%	26.6%	34.6%	43.4%	4.1%	5.3%	6.6%	8.0%	8.8%
11	9.9%	13.8%	18.9%	25.3%	33.0%	41.7%	3.9%	5.1%	6.4%	7.7%	8.7%
13	11.2%	15.6%	21.1%	28.0%	36.1%	45.1%	4.4%	5.5%	6.9%	8.1%	9.0%
15	36.4%	45.4%	54.8%	63.8%	71.9%	78.8%	9.0%	9.4%	9.0%	8.1%	6.9%
18	9.5%	13.2%	18.1%	24.4%	31.9%	40.5%	3.7%	4.9%	6.3%	7.5%	8.6%
21	11.9%	16.4%	22.2%	29.3%	37.6%	46.7%	4.5%	5.8%	7.1%	8.3%	9.1%
23	8.3%	11.6%	16.1%	21.8%	28.8%	37.0%	3.3%	4.5%	5.7%	7.0%	8.2%
25	19.1%	25.6%	33.3%	42.1%	51.4%	60.6%	6.5%	7.7%	8.8%	9.3%	9.2%
26	7.9%	11.1%	15.3%	20.9%	27.7%	35.8%	3.2%	4.2%	5.6%	6.8%	8.1%
28	8.5%	11.9%	16.4%	22.2%	29.3%	37.5%	3.4%	4.5%	5.8%	7.1%	8.2%
30	24.7%	32.3%	40.9%	50.2%	59.4%	68.0%	7.6%	8.6%	9.3%	9.2%	8.6%
31	34.4%	43.2%	52.5%	61.7%	70.0%	77.3%	8.8%	9.3%	9.2%	8.3%	7.3%
33	17.0%	23.0%	30.3%	38.7%	47.8%	57.1%	6.0%	7.3%	8.4%	9.1%	9.3%
34	19.7%	26.3%	34.2%	43.0%	52.3%	61.5%	6.6%	7.9%	8.8%	9.3%	9.2%
35	10.9%	15.1%	20.6%	27.3%	35.3%	44.3%	4.2%	5.5%	6.7%	8.0%	9.0%
40	12.7%	17.5%	23.5%	30.9%	39.4%	48.6%	4.8%	6.0%	7.4%	8.5%	9.2%
41	63.6%	71.8%	78.7%	84.3%	88.6%	91.9%	8.2%	6.9%	5.6%	4.3%	3.3%
43	7.0%	9.9%	13.7%	18.8%	25.1%	32.8%	2.9%	3.8%	5.1%	6.3%	7.7%
44	18.6%	25.0%	32.6%	41.3%	50.6%	59.8%	6.4%	7.6%	8.7%	9.3%	9.2%
46	18.0%	24.2%	31.7%	40.3%	49.5%	58.7%	6.2%	7.5%	8.6%	9.2%	9.2%
55	25.9%	33.7%	42.5%	51.8%	60.9%	69.4%	7.8%	8.8%	9.3%	9.1%	8.5%
57	13.4%	18.3%	24.6%	32.1%	40.8%	50.0%	4.9%	6.3%	7.5%	8.7%	9.2%
58	9.8%	13.6%	18.6%	25.0%	32.6%	41.3%	3.8%	5.0%	6.4%	7.6%	8.7%
59	9.0%	12.5%	17.2%	23.2%	30.6%	39.0%	3.5%	4.7%	6.0%	7.4%	8.4%
60	10.6%	14.7%	20.1%	26.8%	34.7%	43.6%	4.1%	5.4%	6.7%	7.9%	8.9%
61	11.2%	15.4%	21.0%	27.9%	35.9%	44.9%	4.2%	5.6%	6.9%	8.0%	9.0%
63	8.9%	12.4%	17.1%	23.1%	30.4%	38.8%	3.5%	4.7%	6.0%	7.3%	8.4%
64	9.5%	13.3%	18.2%	24.4%	31.9%	40.5%	3.8%	4.9%	6.2%	7.5%	8.6%
65	12.2%	16.9%	22.8%	30.0%	38.4%	47.5%	4.7%	5.9%	7.2%	8.4%	9.1%
66	24.7%	32.3%	40.9%	50.2%	59.4%	68.0%	7.6%	8.6%	9.3%	9.2%	8.6%
68	11.9%	16.5%	22.3%	29.4%	37.7%	46.8%	4.6%	5.8%	7.1%	8.3%	9.1%
70	18.1%	24.3%	31.8%	40.4%	49.6%	58.8%	6.2%	7.5%	8.6%	9.2%	9.2%
72	10.6%	14.7%	20.0%	26.6%	34.6%	43.4%	4.1%	5.3%	6.6%	8.0%	8.8%
73	7.2%	10.1%	14.1%	19.2%	25.7%	33.5%	2.9%	4.0%	5.1%	6.5%	7.8%
9919	12.7%	17.5%	23.5%	30.9%	39.4%	48.6%	4.8%	6.0%	7.4%	8.5%	9.2%
Source:CAN Memorandum for Deputy Chief of Staff, Manpower and Reserve Affairs, 14 May 1999 (CAN 99-0532)											

Table E-2 -- Zone A Reenlistment Rate Estimates for FY 2000 by SRB Level and Occupational Field

Fiscal Year 1999																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	10	26	41	619	1757	3384	5043	2726	2471	91	249	505	771	195	17892
Promoted In	1	3	7	10	116	333	640	1251	1336	0	24	121	308	192	0	4342
Gains (excl Prom)	0	0	0	0	0	10	27	24	13	1399	1	0	0	8	243	1725
Promoted Out	0	1	3	7	10	116	333	640	1194	1336	0	24	178	308	192	4342
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	236	72	4	0	0	0	0	0	312
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	11	4	0	0	0	3	2	4	0	32
Retired (Non-Disability)	1	2	4	4	101	215	209	52	0	0	24	42	62	30	0	746
Other	0	0	0	0	0	3	95	113	137	48	0	0	2	0	2	400
Total Losses	1	3	7	11	115	340	650	1279	1409	1388	24	69	246	345	194	6081
End Strength	4	10	26	40	620	1760	3401	5039	2666	2482	92	301	567	626	244	17878

Table E-3 - Marine Corps Active Duty Officer Flow Management Plan (FY1999)[56]

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56 Office of the Under Secretary of Defense for Personnel and Readiness, *Defense Manpower Requirements Report, Fiscal Year 2000,* p.26, Government Printing Office, Washington, D.C. June 1999

Fiscal Year 2000																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	10	26	40	620	1760	3401	5039	2666	2482	92	301	567	626	244	17878
Promoted In	1	2	7	11	113	326	608	1203	1382	0	23	81	204	240	0	4201
Gains (excl Prom)	0	0	0	0	2	10	25	24	14	1370	0	0	0	7	243	1695
Promoted Out	0	1	2	7	11	113	326	608	1150	1382	0	23	134	204	240	4201
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	240	67	4	0	0	0	0	0	311
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	11	4	0	0	0	3	2	4	0	32
Retired (Non-Disability)	1	2	4	4	101	214	177	83	0	0	24	55	64	23	0	752
Other	0	0	0	0	0	4	122	73	124	50	0	0	2	0	4	379
Total Losses	1	3	6	11	116	337	638	1242	1347	1436	24	81	204	234	244	5924
End Strength	4	9	27	40	619	1759	3396	5024	2715	2416	91	301	567	639	243	17850

Table E-4 – Marine Corps Active Duty Officer Flow Management Plan (FY2000)[57]

[57] Ibid.

Fiscal Year 2001																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	9	27	40	619	1759	3396	5024	2715	2416	91	301	567	639	243	17850
Promoted In	1	3	7	11	107	316	588	1176	1363	0	24	82	205	240	0	4123
Gains (excl Prom)	0	0	0	0	2	10	25	24	14	1370	0	0	0	7	218	1670
Promoted Out	0	1	3	7	11	107	316	588	1123	1363	0	24	135	205	240	4123
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	231	69	0	0	0	0	0	0	300
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	10	4	0	0	0	3	2	4	0	31
Retired (Non-Disability)	1	2	4	4	94	209	170	83	0	0	24	55	63	23	0	732
Other	0	0	0	0	0	4	115	60	119	54	0	0	3	0	3	358
Total Losses	1	3	7	11	109	326	613	1200	1317	1417	24	82	205	235	243	5793
End Strength	4	9	27	40	619	1759	3396	5024	2775	2369	91	301	567	651	218	17850

Table E-5 – Marine Corps Active Duty Officer Flow Management Plan (FY2001)[58]

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58 Ibid.

Fiscal Year 2002																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	9	27	40	619	1759	3396	5024	2775	2369	91	301	567	651	218	17850
Promoted In	1	3	7	11	103	328	628	1270	1328	0	26	80	189	190	0	4164
Gains (excl Prom)	0	0	0	0	1	3	11	30	93	1553	5	0	10	0	224	1930
Promoted Out	0	1	3	7	11	103	328	628	1220	1328	0	26	130	189	190	4164
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	221	74	0	0	0	0	0	0	295
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	5	4	0	0	0	3	2	4	0	26
Retired (Non-Disability)	1	2	4	4	88	215	178	78	0	0	26	52	49	23	0	720
Other	0	0	0	0	0	4	115	105	353	34	0	0	6	20	3	640
Total Losses	1	3	7	11	103	328	628	1270	1653	1362	26	81	189	239	193	6094
End Strength	4	9	27	40	620	1762	3407	5054	2543	2560	96	300	577	602	249	17850

Table E-6 – Marine Corps Active Duty Officer Flow Management Plan (FY2002)[59]

[59] Ibid. p.27

Fiscal Year 2003																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	9	27	40	620	1762	3407	5054	2543	2560	96	300	577	602	249	17850
Promoted In	1	3	7	11	103	328	628	1270	1327	0	26	80	189	190	0	4163
Gains (excl Prom)	0	0	0	0	0	0	0	0	93	1361	0	0	0	0	200	1654
Promoted Out	0	1	3	7	11	103	328	628	1220	1327	0	26	130	189	190	4163
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	221	74	0	0	0	0	0	0	295
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	11	4	0	0	0	3	2	4	0	32
Retired (Non-Disability)	1	2	4	4	88	215	170	78	0	0	26	51	53	22	0	714
Other	0	0	0	0	0	4	117	105	99	34	0	0	2	0	3	364
Total Losses	1	3	7	11	103	328	628	1270	1399	1361	26	80	189	218	193	5817
End Strength	4	9	27	40	620	1762	3407	5054	2564	2560	96	300	577	574	256	17850

Table E-7 – Marine Corps Active Duty Officer Flow Management Plan (FY2003)[60]

60 Ibid.

Fiscal Year 2004																
	Commissioned Officers										Warrant Officers					
Grade	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	W-5	W-4	W-3	W-2	W-1	Total
Begin Strength	4	9	27	40	620	1762	3407	5054	2564	2560	96	300	577	574	256	17850
Promoted In	1	3	7	11	103	328	627	1270	1327	0	26	85	191	190	0	4169
Gains (excl Prom)	0	0	0	0	0	0	0	0	93	1361	0	0	0	0	200	1654
Promoted Out	0	1	3	7	11	103	328	627	1220	1327	0	26	135	191	190	4169
Deaths	0	0	0	0	1	1	2	3	3	0	0	0	2	3	0	15
End Of Obligation	0	0	0	0	0	0	0	221	79	0	0	0	0	0	0	300
Paid Separations	0	0	0	0	0	0	0	231	3	0	0	0	0	0	0	234
Retired (Disability)	0	0	0	0	3	5	11	4	0	0	0	3	2	4	0	32
Retired (Non-Disability)	1	2	4	4	88	216	172	78	0	0	26	56	50	22	0	719
Other	0	0	0	0	0	4	117	115	100	34	0	0	2	0	3	375
Total Losses	1	3	7	11	103	329	630	1279	1405	1361	26	85	191	220	193	5844
End Strength	4	9	27	40	620	1761	3404	5045	2579	2560	96	300	577	544	263	17829

Table E-8 – Marine Corps Active Duty Officer Flow Management Plan (FY2004)[61]

61 Ibid.

Fiscal Year 1999											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	45	2					58
29					22	4					26
28					13	3					16
27					10	7					17
26					7	8					15
25					6	18					24
24					1	25					26
23						36	1				37
22						47	3				50
21						44	90				134
20						21	105				126
19						2	5				7
18						2	4				6
17						1	3				4
16							2	1			3
15							2	3			5
14							2	2			4
13							2	15			17
12							1	12			13
11								10			10
10								8			8
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	104	220	220	56	0	0	611

Table E-9 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY1999)[62]

[62] Ibid. p.36

Fiscal Year 2000											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	49	2					62
29					23	4					27
28					11	3					14
27					9	7					16
26					5	8					13
25					6	18					24
24					1	25					26
23						36	1				37
22						47	3				50
21						44	85				129
20						21	88				109
19						2	1				3
18						2	1				3
17							1				1
16							1	2			3
15							2	7			9
14							2	7			9
13							2	21			23
12							1	17			18
11								16			16
10								12			12
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	104	219	188	87	0	0	609

Table E-10 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY2000)[63]

[63] Ibid.

Fiscal Year 2001											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	45	2					58
29					16	4					20
28					13	3					16
27					11	7					18
26					5	8					13
25					6	18					24
24					1	23					24
23						34	1				35
22						46	2				48
21						44	80				124
20						21	87				108
19						2	1				3
18						2	1				3
17							1				1
16							1	2			3
15							2	7			9
14							2	7			9
13							1	21			22
12							1	17			18
11								16			16
10								12			12
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	97	214	180	87	0	0	589

Table E-11 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY2001)[64]

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64 Ibid. p.37

Fiscal Year 2002											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	43	2					56
29					16	4					20
28					11	3					14
27					9	7					16
26					5	8					13
25					6	18					24
24					1	25					26
23						36	1				37
22						48	3				51
21						44	80				124
20						21	88				109
19						2	1				3
18						2	1				3
17							1				1
16							1	2			3
15							2	7			9
14							2	6			8
13							2	18			20
12							1	16			17
11								16			16
10								12			12
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	91	220	183	82	0	0	587

Table E-12 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY2002)[65]

[65] Ibid.

Fiscal Year 2003											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	43	2					56
29					16	4					20
28					11	3					14
27					9	7					16
26					5	8					13
25					6	18					24
24					1	25					26
23						36	1				37
22						48	3				51
21						44	80				124
20						21	87				108
19						2	1				3
18						2	1				3
17							1				1
16							1	2			3
15							2	7			9
14							2	6			8
13							1	18			19
12							1	16			17
11								16			16
10								12			12
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	91	220	181	82	0	0	585

Table E-13 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY2003)[66]

[66] Ibid. p.38

Fiscal Year 2004											
	Grade										
YACS	O-10	O-9	O-8	O-7	O-6	O-5	O-4	O-3	O-2	O-1	Total
30	1	2	4	4	43	2					56
29					16	4					20
28					11	3					14
27					9	7					16
26					5	8					13
25					6	18					24
24					1	25					26
23						36	1				37
22						49	3				52
21						44	82				126
20						21	87				108
19						2	1				3
18						2	1				3
17							1				1
16							1	2			3
15							2	7			9
14							2	6			8
13							1	18			19
12							1	16			17
11								16			16
10								12			12
9								3			3
8								1			1
7								1			1
6											0
5											0
4											0
3											0
2											0
1											0
Total	1	2	4	4	91	221	183	82	0	0	588

Table E-14 -- Marine Corps Officer Retirements by Grade and Years of Active Commissioned Service (YACS) (FY2004)[67]

[67] Ibid.

APPENDIX F: RECRUITING DATA AND METRICS

This appendix presents the available data as outlined in Table 5-14 for developing the recruiting screen of SimMarineCorps. This appendix has two sections presenting the raw data collected, and a model from relevant literature to show the relationships of the appropriate metrics as outlined in Table 5-14.

A. RECRUITING DATA

Table F-1 shows Marine Corps enlisted recruiting goals in terms of gross numbers for FY00-FY05. A breakdown by mental category was requested from MCRC but not provided. To offset this deficiency Table F-2 shows a snapshot of the aggregate quality level of recruits entering the Marine Corps in FY99. Table F-3 shows officer accessions by source for FY99. Lastly, Figure F.1 shows a graph of propensity to enlist among the available individual potential recruits.

Marine Corps Enlisted Recruiting Goals for FY00-FY05	
Fiscal Year	*Goal*
FY2000	33,368
FY2001	35,082
FY2002	36,568
FY2003	33,680
FY2004	35,006
FY2005	35,198

Table F-1 - Marine Corps Enlisted Recruiting Goals (FY00-FY05)[68]

Marine Corps Enlisted Recruits Quality Profile for FY99
Quality Levels
95.8% Tier 1 High School Grads
65.7% Upper Half of Mental Groups
3.6% Used Drugs in Previous 30 Days
7.8% Used Drugs in Previous Year
Only 1231 Deserters (including long- term)

Table F-2 - Marine Corps Enlisted Recruits Quality Profile (FY99)[69]

[68] Source HQMC

[69] Source MCRC

Marine Corps Officer Accessions by Source (FY99)		
Source	*Accessions*	*Percent of Total*
United States Naval Academy (USNA)	145	8.1%
Naval Reserve Officer Training Corps (NROTC)	170	9.4%
Platoon Leaders Course (PLC)	322	17.9%
Officers Candidate Course (OCC)	436	24.1%
Marine Enlisted Commissioning Education Program (MECEP)	131	7.2%
Enlisted Commissioning Program (ECP)	138	7.6%
Warrant Officer's	243	13.4%
Other	223	12.3%
Total	1808	100.0%
Source: MCRC (As of FY99)		

Table F-3 - Marine Corps Officer Accession by Source for FY99

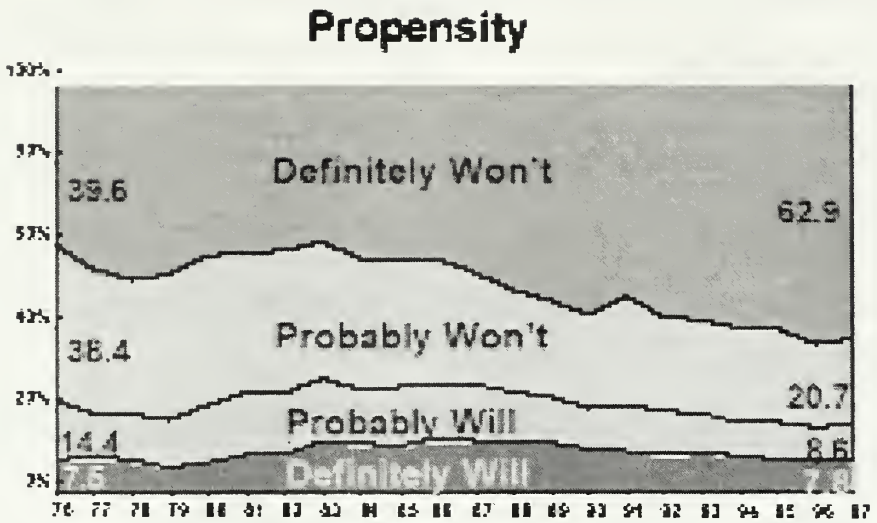

Figure F.1 – Available Recruit Population Propensity to Enlist[70]

B. RECRUITING METRICS

This section presents a model from a 1990 study done by John T. Warner. This study will be used to identify the four metrics outlined in Table 5-14 that pertain to recruiting, they are:

- The effect of adding additional recruiters on actual number enlisted/accessed.
- The effect of adding advertising dollars on actual number of enlisted/accessed.
- The effects of other services recruiting efforts.

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[70] Source U.S. Army Recruiting Command (USAREC)

- The effect of enlistment bonuses/college fund on propensity to enlist.

An extensive search of the relevant literature did not reveal any current studies pertaining to Marine Corps Recruiting therefore the study titled, *"Military Recruiting Programs During the 1980s: Their Success and Policy Issues,"* will be used. The estimated model is as follows:

$$H/P = f(M/C, U, REC/P, GOAL/P, ADV, EDBEN, OSREC/P, OSGOAL/P, OSADV, JSADV, QTR)$$ [71]

Where:

- H is the given service's high-quality enlistments.
- P is the 17-21 year-old population of high-quality male youth.
- M/C is an index of military pay relative to civilian pay.
- U is the civilian unemployment rate.
- REC is the given service's recruiter force.
- GOAL is the given service's goal.
- ADV is the given service's advertising expenditures.
- EDBEN is the present value of educational benefits at enlistment.

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[71] Warner, John T., *Military Recruiting Programs During the 1980s: Their Success and Policy Issues,* Western Economic Association International, Contemporary Policy Issues, Volume VIII, p. 63, October 1990

- OSREC is the sum of other services' recruiter strengths.
- OSGOAL is the sum of other services' recruiting goals.
- OSADV is the sum of other services' advertising expenditures.
- JSADV is Joint Service advertising expenditures.
- QTR is three fiscal quarter dummies.

Warner ran two separate models, the first model (Model A) included a time trend and the second model (Model B) did not. The models were estimated by combining quarterly data for 41 Navy Recruiting Districts (NRD's) for the period 1981-1987. A total of 1,148 observations comprise the analysis. All variables were measured logarithmically. The model was estimated using a fixed-effects estimator. Each variable is measured as the deviation in a given quarter from the average value of the variable in the given NRD over the 28-quarter sample period. The fixed effects estimator is useful for two reasons. First, it removes the influence of unobservable factors that vary across districts but not over time. Second, it removes the influence of district size. Regression results are shown at Table F-4 and the estimated percentage change in high-quality enlistments due

to a 10 percent increase in the listed factors are shown at Table F-5.

Regression Models of High-Quality Enlistments								
	Army		*Navy*		*Air Force*		*Marine Corps*	
Parameter	***A***	***B***	***A***	***B***	***A***	***B***	***A***	***B***
Intercept	-3.461 (.438)[a]	-3.985 (.454)[a]	0.097 (.239)	-0.283 (.226)	0.849 (.265)[a]	0.577 (.295)[a]	-0.113 (.262)	-0.776 (.055)[a]
Pay	-0.508 (.265)[a]	1.026 (.269)[c]	2.044 (.211)[a]	2.463 (.192)[a]	-0.346 (.261)	0.499 (.227)[b]	0.340 (.286)	2.555 (.229)[b]
Unemployment	0.554 (.026)[a]	0.451 (.025)[a]	0.477 (.024)[a]	0.441 (.022)[a]	0.203 (.028)[a]	0.139 (.027)[a]	0.483 (.030)[a]	0.402 (.031)[a]
Own Service Recruiters	0.371 (.074)[a]	0.482 (.076)[a]	0.412 (.047)[a]	0.459 (.047)[a]	-0.045 (.050)	-0.168 (.048)[a]	0.487 (.076)[a]	0.957 (.066)[a]
Other Service Recruiters	0.254 (.066)[a]	0.599 (.058)[a]	0.196 (.081)[a]	0.320 (.077)[a]	0.062 (.083)	0.396 (.066)[a]	-0.067 (.104)	0.121 (.108)
Own Service HQ Goal	0.215 (.023)[a]	0.299 (.022)[a]	0.257 (.059)[a]	0.316 (.058)[a]				
Own Service Other Goal	0.010 (.023)	-0.005 (.024)	-0.103 (.048)[a]	-0.165 (.048)[a]				
Own Service Total Goal					0.280 (.055)[a]	0.318 (.055)[a]	0.032 (.047)	-0.195 (.046)[a]
Other Service Total Goal	-0.105 (.057)[a]	-0.129 (.058)[a]	0.079 (.058)	0.119 (.058)[a]	0.526 (.081)[a]	0.491 (.082)[a]	0.080 (.072)	0.075 (.077)
Own Service Educational Benefits	0.368 (.049)[a]	0.424 (.050)[a]	0.133 (.024)[a]	0.149 (.023)[a]	-0.064 (.032)[a]	-0.027 (.031)	0.035 (.029)	0.128 (.030)[a]
Own Service Advertising	0.103 (.040)[a]	0.198 (.041)[a]	0.015 (.008)[a]	0.015 (.008)[a]	-0.034 (.007)	-0.038 (.015)[a]	-0.017 (.005)[a]	0.001 (.020)
Other Service Advertising	-0.007 (.015)	-0.006 (.015)	-0.396 (.049)[a]	-0.265 (.039)[a]	-0.149 (.033)[a]	-0.100 (.032)[a]	-0.081 (.035)[a]	0.020 (.036)
Joint Service Advertising	0.000 (.003)	0.001 (.003)	-0.004 (.004)	0.003 (.004)	0.004 (.003)	0.003 (.004)	0.001 (.004)	0.004 (.004)
Time	0.015 (.001)[a]		0.006 (.001)[a]		0.009 (.001)[a]		0.022 (.002)[a]	
R^2	0.830	0.817	0.644	0.642	0.279	0.255	0.680	0.641
Note: Standard errors are in parentheses. Model also contained quarterly dummies								
[a]Significant at 0.01 level. [b]Significant at 0.05 level. [c]Significant at 0.10 level.								

Table F-4 -- Regression Models of High-Quality Enlistments[72]

[72] Ibid. pp. 65-66

Estimated Percentage Change in High-Quality Enlistments Due to a 10 Percent Increase in Various Factors								
	Army		*Navy*		*Air Force*		*Marine Corps*	
Factor:	***A***	***B***	***A***	***B***	***A***	***B***	***A***	***B***
Pay	5.1	10.3	20.6	24.6	0	5.0	0	25.6
Unemployment	5.5	4.5	4.8	4.4	2.0	1.4	4.8	4.4
Own-Service Recruiters	3.7	4.8	4.1	4.6	-0.5	-1.7	4.8	9.6
Own-Service HQ Goal	2.2	3.0	2.6	3.2				
Own-Service Other Goal	0	0	-1.0	-1.7				
Own-Service Total Goal					2.8	3.2	0	-2.0
Own-Service Advertising	1.0	2.0	0.2	0	-3.4	-3.8	0	0
Joint Service Advertising	0	0	0	0	0	0	0	0
Own-Service Educational Benefits	3.7	4.2	1.3	1.5	-6.4	0	0	1.3
Note: Model A included a time trend, while model B did not.								

Table F-5 - Estimated Percentage Change in High-Quality Enlistments due to a 10 Percent Increase in Various Factors

APPENDIX G: TRAINING DATA AND METRICS

This appendix lists all data that was available/provided at the time of writing of this thesis. The data presented here will support the development of the three training screens (Figures 5.7, 5.8, and 5.9) as outlined in chapter 5 section F.7. The data includes a distribution of training and education funds for FY00 by category (Table G-1) and by command/school (Table G-2). A sample list of MOS's with course length and MOS description (Table G-3). Table G-3 shows the MOS track (some MOS's have two tracks, this is because the MOS is taught at more than one location., e.g., MOS 0311 is taught at School of Infantry (SOI) on the west coast and east coast.), course length in days, and an MOS description. The complete list is too long to include in full, however it may be obtained in full from CG, MCCDC, T&E Division upon request. A breakdown of the training manpower structure, which lists training organizations, identifies their T/O number, and breaks down required manning level by instructor and support personnel, further divided by active duty officer and enlisted, civilian employees, and reserve (full-time support) officers and enlisted (Table G-4). The last piece of data provided is a sample of the Marine Corps Training Category Report by Service Facility and School (Table G-5).

This report is too large to place within this appendix but is available from CG, MCCDC, T&E Division upon request.

CURRENT TRAINING BUDGET (by Training Categories)	AMOUNT
Current Training Budget for Initial Entry Training (Recruit Training)	$10,245,000
Current Training Budget for Initial Entry Training (Officer Acquisition)	$293,000
Current Training Budget for Professional Development Education	$8,600,000
Current Training Budget for Specialized Skill Training	$26,827,000
Current Training Budget Total	**$45,965,000**

Table G-1: Current Training Budget by Category for FY00

TRAINING COST (by Command/School)	AMOUNT
MCRD, Parris Island	$5,197,000
MCRD, San Diego	$5,435,000
MCCDC	$6,959,000
MCB Lejeune	$6,852,000
MCAGCC 29 Palms	$10,867,000
MCB Camp Pendleton	$3,849,000
MARCORSYSCOM	$533,000
Camp Butler	$120,000
Kaneohe Bay	$65,000
MCB Quantico	$7,789,000
MCDET Fort Meade	$21,560
MCDET Keesler AFB	$121,560
MCDET Monterey	$74,450
MCDET Redstone	$31,850
MCDET Fort Gordon	$31,000
MCDET Aberdeen	$449,500
MCDET Fort Sill	$99,636
MCDET Fort Bliss	$667,000
MCDET Fort Knox	$104,000
MCDET Fort Leonardwood	$1,272,000
MCDET Newport RI	$48,220
MCDET Lackland AFB	$32,500
MCDET Fort Lee	$353,790
MCDET Dam Neck	$125,250
MCDET Fort Huachuca	$34,700
MCDET Good Fellow AFB	$26,300
EWTGLANT	$1,194,000
EWTGPAC	$1,002,000
MATSG Pensacola	$946,000
MATSG Corpus Christi	$55,000
MATSG Whidbey Island	$95,410
MATSG Meridian	$61,000
Financial Management School	$161,000
Supply School	$215,000
Motor Transport School	$2,030,000
AdministratiGon School	$127,000
IMS	$58,000
MCSSS	$676,000
Logistics School	$159,000
MCES	$945,000
SOI	$2,004,000

Table G-2 - Current Training Budget by Command/School for FY00

MOS	Track	Length	MOS Description
0121	1	47	Personnel Clerk
0151	1	52	Administrative Clerk
0161	1	35	Postal Clerk
0170	1	51	Personnel Officer
0180	1	38	Adjutant
0193	1	51	Personnel/Administrative Chief
0202	1	109	MAGTF Intelligence Officer
0203	1	159	Ground Intelligence Officer
0204	1	124	Human Source Intelligence Officer
0206	1	110	Signal Intelligence/Ground Electronic Intelligence Officer
0207	1	138	Aviation Intelligence Officer
0211	1	124	Counterintelligence Specialist
0212	1	287	Technical Surveillance Countermeasures (TSCM) Specialist
0215	1	287	Technical Surveillance Countermeasures (TSCM) Officer
0231	1	84	Intelligence Specialist
0241	1	168	Imagery Interpretation Specialist
0251	1	70	Interrogation-Translation Specialist
0261	1	259	Topographic Intelligence Specialist
0302	1	68	Infantry Officer
0303	1	35	Light Armored Vehicle Officer
0306	1	110	Infantry Weapons Officer
0311	1	36	Rifleman
0311	2	36	Rifleman
0313	1	81	LAV Crewman
0321	1	111	Reconnaissance Man
0321	2	111	Reconnaissance Man
0331	1	53	Machine Gunner
0331	2	53	Machine Gunner
0341	1	53	Mortarman
0341	2	53	Mortarman
0351	1	53	Assaultman
0351	2	53	Assaultman
0352	1	50	Antitank/Assault Guided Missile Man
0352	2	50	Antitank/Assault Guided Missile Man
0369	1	55	Infantry Unit Leader
0369	2	55	Infantry Unit Leader

Table G-3 – Sample MOS Course Training Length and Description

TRAINING MANPOWER STRUCTURE

T/O	ORGANIZATION	INSTR	SUPT	MARINE OFF	MARINE ENL	CIV	RESERVE (FTS) OFF	RESERVE (FTS) ENL
5001	Marine Corps Assigned to OSD and DOD Activities	0	*14*	3	2	0	7	2
5002	Marine Corps Assigned to the Joint Staff	0	*1*	0	0	0	1	0
5010	Marine Corps Assigned to Allied/UN Commands	0	*0*	0	0	0	0	0
5012	Marine Corps Assigned to the Rapid Deployment Joint Task Force	0	*2*	0	0	0	1	1
5051	Marine Corps Personnel with DON-Nondepartmental	10	*9*	4	15	0	2	3
5052	Marine Corps Personnel with USA and USAF	0	*3*	3	0	0	0	0
5060	Marine Corps Billets at Joint and Other Service Schools	753	*403*	188	958	7	0	3
5146	Marine Corps Institute, Washington, DC	62	*111*	17	114	39	1	2
5980	Expeditionary Warfare Training Group, Atlantic, Little Creek, VA	50	*98*	36	85	24	1	2
5981	Expeditionary Warfare Training Group, Pacific, Coronado, CA	84	*30*	36	63	11	0	4
	TOTAL	*959*	*671*	287	1237	81	13	6
5996	COMTRAPAC, Fleet Intelligence Trng Center, COMPHIBGRU 3 Tactical Training Group, Pacific	1	*2*	2	0	0	1	0
	MCRD, San Diego, CA							
7211	HQ & Service Bn, Marine Corps Recruit Depot, San Diego, CA	12	*837*	71	533	245	0	0
7221	HQ Co, Support Bn, Recruit Trng Regiment, MC Recruit Depot, San Diego, CA	110	*113*	27	193	3	0	0
7222	Recruit Trng Bn, Recruit Trng Regiment, MC Recruit Depot, San Diego, CA	372	*99*	60	411	0	0	0
7240	Weapons and Field Trng Bn, MC Recruit Depot, San Diego, CA	285	*117*	19	383	0	0	0
	TOTAL	*779*	*1166*	177	1520	248	0	0
	MCRD, Parris Island, SC							
7311	HQ and Service Bn, Marine Corps Recruit Depot, Parris Island, SC	15	*1078*	83	720	290	0	0
7321	Recruit Trng Regiment, Marine Corps Recruit Depot, Parris Island, SC	173	*154*	36	284	7	0	0
7322	Recruit Trng Bn, Marine Corps Recruit Depot, Parris Island, SC	357	*186*	57	486	0	0	0
7323	Weapons Tng Bn, Marine Corps Recruit Depot, Parris Island, SC	236	*69*	13	292	0	0	0
	TOTAL	*781*	*1487*	189	1782	297	0	0
	MCCDC, Quantico, VA							
7402	Training and Education Division , MCCDC	3	*189*	67	57	47	20	1
7403	MAGTF Staff Training Program Center	16	*30*	26	13	7	0	0
7421A	Marine Corps University/Marine Corps Research Center, MCCDC	5	*72*	17	22	38	0	0
7422	Command & Staff College, Marine Corps University, MCCDC	15	*35*	20	6	21	3	0
7423	Amphibious Warfare School, Marine Corps University, MCCDC	16	*21*	21	9	6	1	0
7424	Communication Officers School, Marine Corps University, MCCDC	13	*83*	16	76	4	0	0
7426	Staff Noncommissioned Officer Academy, MCU, MCCDC	30	*16*	0	44	0	0	2
7427	The Basic School, Marine Corps University, MCCDC	88	*664*	137	597	18	0	0
7428	Officers Candidate School, Marine Corps University, MCCDC	17	*149*	30	134	2	0	0
7429	Weapons Training Battalion, MCCDC	104	*133*	24	211	2	0	0
	TOTAL	*307*	*1392*	358	1169	145	24	3
	MCB Camp Lejeune, NC							
7540	Marine Corps Engineer School, Marine Corps Base, Camp Lejeune, NC	65	*88*	13	132	8	0	0
7551	Marine Corps Service Support Schools, Marine Corps Base, Camp Lejeune, NC	11	*99*	14	87	9	0	0
7552	Supply School, Marine Corps Base, Camp Lejeune, NC	41	*16*	10	45	2	0	0
7554	Motor Transportation School, Marine Corps Base, Camp Lejeune, NC	127	*79*	7	174	22	0	3
7555	Personnel Administration School, Marine Corps Base, Camp Lejeune, NC	54	*19*	5	68	0	0	0
7556	Staff Noncommissioned Officers Academy, MCU, MCB, Camp Lejeune, NC	31	*15*	0	46	0	0	0
7557	Financial Management School, MCB, Camp Lejeune, NC	15	*18*	6	24	3	0	0
7561A	School of Infantry, MCB, Camp Lejeune, NC	275	*349*	46	548	4	3	23
7570	Field Medical Service School, MCB, Camp Lejeune, NC	6	*6*	0	11	1	0	0
	TOTAL	*625*	*689*	101	1135	49	3	26

	MCB Camp Pendleton, CA							
7611	HQ Bn, MCB, Instructional Management School, Camp Pendleton, CA	6	*3*	1	6	2	0	0
7632	Assault Amphibious School, MCB, Camp Pendleton, CA	56	*136*	9	181	2	0	0
7650	Field Medical Service School, MCB, Camp Pendleton, CA	6	*4*	1	9	0	0	0
7661A	School of Infantry, MCB, Camp Pendleton, CA	286	*361*	51	569	2	3	22
7671	Mountain Warfare Training Center, Bridgeport, CA	63	*169*	14	195	23	0	0
	TOTAL	*417*	*673*	76	960	29	3	22
	Twentynine Palms, CA							
7720	Marine Corps Communications-Electronic School, Twentynine Palms, CA	297	*388*	44	546	95	0	0
7721	Noncommissioned Officers School, MCU, Twentynine Palms, CA	9	*10*	0	19	0	0	0
	TOTAL	*306*	*398*	44	565	95	0	0
7805	Staff Noncommissioned Officers Academy, MCU Camp Butler, Okinawa	16	*18*	0	34	0	0	0
7820	Staff Noncommissioned Officers Academy, MCU, MCAS, El Toro, CA	34	*12*	0	46	0	0	0
7821	Noncommissioned Officers School, MCU, MCAS, Kaneohe Bay, HI	10	*5*	0	15	0	0	0
	TOTAL	*60*	*35*	0	95	0	0	0
	Aviation Training							
8240	Marine Aviation Training Support Group, Pensacola, FL (combined)	428	*221*	206	437	6	0	0
8224	Fleet Aviation Specialized Operational Training Group, Cherry Point, NC/El To	22	*5*	0	27	0	0	0
8225	Marine Aviation Training Support Group, Meridian, MS	28	*18*	3	43	0	0	0
8230	Marine Aviation Training Support Group, Cecil Field, FL	1	*15*	4	12	0	0	0
8250	Marine Aviation Training Support Group, Corpus Christi, TX	70	*20*	74	16	0	0	0
8265	Marine Aviation Training Support Group, Lemoore, CA	0	*17*	3	14	0	0	0
8275	Marine Aviation Training Support Group, Whidbey Island, WA	0	*13*	3	10	0	0	0
	TOTAL	*549*	*309*	293	559	6	0	0
	Non-T&E Schools							
5153	*Marine Security Guard Battalion*	*8*	*86*	10	84	0	0	0
	TOTAL	4783	6820	1525	9022	950	43	57
	TOTAL	*11597*						

Table G-4 – Training Manpower Structure by T/O and Organization

Service **M MARINE CORPS**

Facility 02 MCCDC QUANTICO, VA

School 2 *COMMAND AND CONTROL SYSTEMS SCHOOL*

COURSE_ID	*COURSE_NAME*	*Length*	*Capacity*	*Rqmt*	*Input*	*Grads*	*Load*
M02CGT2	COMMUNICATION INFORMATION SYSTEMS OFFICER REFRESHER (CISOR) COURSE	14	50	0	27	27	1
		School totals		*0*	*27*	*27*	*1*

School 4 *THE BASIC SCHOOL*

COURSE_ID	*COURSE_NAME*	*Length*	*Capacity*	*Rqmt*	*Input*	*Grads*	*Load*
M02H4R4	CLOSE COMBAT INSTRUCTOR TRAINER COURSE	28	48	0	50	50	3
		School totals		*0*	*50*	*50*	*3*

School 7 *MARINE SECURITY GUARD BATTALION*

COURSE_ID	*COURSE_NAME*	*Length*	*Capacity*	*Rqmt*	*Input*	*Grad*	*Load*
M0258L7	MARINE SECURITY GUARD SUPERVISOR	56	125	0	64	42	8
M0281H7	MARINE SECURITY GUARD	47	855	0	740	540	82
		School totals		*0*	*804*	*582*	*90*

School 9 *WEAPONS TRAINING BATTALION*

COURSE_ID	*COURSE_NAME*	*Length*	*Capacity*	*Rqmt*	*Input*	*Grads*	*Load*
M0281Z9	SCOUT-SNIPER	63	48	48	18	10	2
M02H4S9	SNIPER EMPLOYMENT OFFICER COURSE	14	8	0	7	7	0
M02KAL9	URBAN MOBILITY BREACHER COURSE	12	28	0	31	29	0
M02M4G9	RANGE OFFICER	30	12	15	6	6	0
		School totals		*63*	*62*	*52*	*2*

School A *CAREER PLANNER SCHOOL*

COURSE_ID	*COURSE_NAME*	*Length*	*Capacity*	*Rqmt*	*Input*	*Grads*	*Load*
M0281DA	CAREER PLANNER	26	240	207	118	117	8
		School totals		*207*	*118*	*117*	*8*

Facility totals *270 1061 828 104*

Table G-5: Sample Marine Corps Training Category Report by Service, Facility, and School

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APPENDIX H: OVERALL STRATEGIC AND GEOPOLITICAL ENVIRONMENT

This Appendix describes the overall strategic and geopolitical environment which is modeled in the Firm Handshake business wargame.

The end of the 20th Century is very much a prelude to the opening decades of the 21st Century. We can reasonably assume that the United States will remain engaged internationally, retaining its leadership role in multinational defense arrangements and in promoting democratic values, free markets, and human rights. We can also reasonably assume that the future will be even more complex, uncertain, and challenging than today. The challenges, which face us in the future, include:

- *Failed and Failing States.* The integrative factors accelerating globalization and economic interdependence will clash with the disintegrative forces of ethnicity, economic protectionism, and historical disputes. Some states will fail, while others grow in strength and influence.
- *Transnational Threats.* Many threats will transcend the state model. New ways will be found to exploit the power of information--for good and bad purposes.

Transnational crime, terrorism, and illicit drug trafficking may proliferate.

- *Asymmetric Challenges.* Both state and non-state actors are adapting to avoid the strategic advantages of the United States. They are actively seeking asymmetric strategies and niche capabilities to counter U.S. strengths or exploit U.S. vulnerabilities. Some asymmetric techniques will be defensive, such as high mobility, burrowing, or shielding in urban areas. Others are offensive techniques, such as Weapons of Mass Destruction (WMD), terrorism, missile strikes against the homeland, or covert operations targeted at commercial or financial infrastructures.
- *Rise of a Major Military Competitor.* Finally, from a security perspective, we cannot dismiss the fact that the future may be more than a linear projection of the present. While a major military competitor is unlikely to emerge before the 2020 timeframe, prudent military planning must consider the possibility of such an emergence as early as 2015.
- *A Global Economy.* The dramatic growth of the Internet and e-commerce has profound implications

for regional economies as well as the emergence of an overall global economy.[73]

Based on these challenges the United States will require a world class Army capable of rapid response and dominance across the entire spectrum of operations. Through the use of business wargaming we can hope to capture many of the complexities listed above and test the many paths that will lead us to the Army described above.

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[73] Dolk, Daniel, R. "Firm Handshake, A Business Wargame for the Army," 24 January 2000, pp. 4-5

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